TIDAL HARBOURS COMMISSION.

SECOND REPORT

OF

THE COMMISSIONERS,

WITH

MINUTES OF EVIDENCE,

APPENDICES,

SUPPLEMENT AND INDEX.

Presented to both Houses of Parliament by Command of Her Majesty.

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COMMISSION.

VICTORIA, BY THE GRACE OF GOD, of the United Kingdom of *Great Britain* and *Ireland* Queen, Defender of the Faith. TO Our trusty and well-beloved *William Bowles*, Esquire, Companion of Our Most Honourable Military Order of the Bath, Rear Admiral of the Blue Squadron of Our Fleet; Sir *James John Gordon Bremer*, Knight Commander of Our Most Honourable Military Order of the Bath, Captain in Our Navy; *Joseph Hume*, *Aaron Chapman*, *Edward Royd Rice*, and *Thomas Baring*, Esquires; Our trusty and well-beloved *Francis Beaufort*, Esquire, Captain in Our Navy, Hydrographer of Our Admiralty, or the Hydrographer of Our Admiralty for the time being; *George Biddell Airy*, Esquire, Our Astronomer, or Our Astronomer for the time being; Our trusty and well-beloved *John Washington*, Esquire, Captain in Our Navy; and *Richard Godson*, Esquire, Counsel for the Affairs of Our Admiralty and Navy for the time being, greeting: Whereas We did, by Our Letters Patent under the Great Seal of Our United Kingdom of Great Britain and Ireland, bearing date at Westminster the First day of February, in the Eighth year of Our Reign, nominate, constitute, and appoint you the said *Joseph Hume*, *Aaron Chapman*, *Edward Royd Rice*, *Thomas Baring*, *Francis Beaufort*, or the Hydrographer of Our Admiralty for the time being, *George Biddell Airy*, or Our Astronomer for the time being, and *John Washington*, together with Our right trusty and well-beloved Councillor *Henry Thomas Lowry Corry*, and Our trusty and well-beloved *Henry John Shepherd*, Esquire, to be Our Commissioners for inquiring into the state and condition of the Harbours, Shores, and Navigable Rivers of Our United Kingdom of Great Britain and Ireland, and as to the powers of the Commissioners deputed and assigned for Executing the Office of Our High Admiral of Our said United Kingdom of Great Britain and Ireland for the conservation of the same; And also what Measures might be necessary for removing and preventing impediments to Navigation: NOW KNOW YE that We have revoked and determined, and by these presents do revoke and determine, the said recited Letters Patent, and every clause, article, and thing therein contained: AND FURTHER KNOW YE that We, confiding very much in your fidelity, discretion, diligence, and careful circumspection of Our especial Grace, certain knowledge, and mere motion, have nominated, constituted, and appointed, and by these Presents do nominate, constitute, and appoint you the said *William Bowles*, Sir *James John Gordon Bremer*, *Joseph Hume*, *Aaron Chapman*, *Edward Royd Rice*, *Thomas Baring*, *Francis Beaufort*, or the Hydrographer of Our Admiralty for the time being, *George Biddell Airy*, or Our Astronomer for the time being, *John Washington* and *Richard Godson*, or Our Counsel for the affairs of Our Admiralty and Navy for the time being, Our Commissioners for the purposes herein-after mentioned.

AND We do by these presents give and grant unto you, or any five or more of you, full power and authority to inquire into the state and condition of the Tidal and other Harbours, Shores, and Navigable Rivers of Our United Kingdom of Great Britain and Ireland; and to ascertain what changes have taken place in any of such Harbours, Shores, and Rivers, as respects Bars, Entrance, Depth of Water, extent and amount of Scour, or otherwise; and what encroachments have been made upon them, or upon the Waters above such Harbours and Rivers, by Enclosures of Lands, Embankments, Wharfs, Piers, or other works, and by whom and by what authority such Encroachments have been made, what effect they have or may hereafter produce, and also what injury may have been done, or may accrue, by the removal of Shingle, Rock, Soil, or other materials, from any Shores, or by the emptying Ballast or other materials into or near any such Harbours and Rivers, or in consequence of Wreck not being removed, and what Measures are necessary and expedient to remedy and prevent any injury that may have resulted, or may be likely to result, therefrom; and also whether there are sufficient powers for enforcing such remedy, and whether any and what further powers are necessary.

AND We do further by these Presents give and grant unto you Our said Commissioners, or any five or more of you, full power and authority to inquire into the present state of the Law as regards the powers of the Commissioners deputed and assigned for executing the Office of Our High Admiral of Our United Kingdom, for the conservation of all Harbours, Shores, and Rivers of Our said Kingdom; and how far the powers given to any Bodies Corporate, Commissioners, Trustees, Local Authorities, or other persons, by any Charters or other Acts of Us or of Our Predecessors, Kings and Queens of England, Scotland, and Ireland, or by any public, local, or private Acts of Parliament, supersede or interfere with the powers and authority of the Commissioners assigned and deputed to execute the Office of Our High Admiral of Our United Kingdom; and whether any, and, if any, what Legislative Measures or other Acts are necessary to confer upon the same Commissioners sufficient powers to remove or prevent encroachments, or the constructions of any work, or for the removal of Wreck, or for preventing any act which has, or has a tendency to have, an injurious effect on any Harbour, Shore, or Navigable River of Our said United Kingdom.

AND We do further by these Presents give and grant unto you Our said Commissioners, or any five or more of you, full power and authority to inquire and ascertain what measures you may deem expedient for the improvement of the Harbours and Rivers of Our same Kingdom.

AND We do further by these Presents authorize and empower you, or any one or more of you, to visit and personally inspect all the Harbours, Shores, and Navigable Rivers of Our United Kingdom, or such of them as you may deem expedient, and to employ Engineers and other persons to make surveys of such Harbours, Shores, and Navigable Rivers, who are to report thereon to you.

AND We do by these Presents give and grant to you, or any one or more of you, full power and authority to call before you, or any one or more of you, at any place you, or any one or more of you, may think necessary, such persons as you, or any one or more of you, shall judge requisite by whom you may be better informed of the truth in the premises, or from whom you, or any one or more of you, may consider it desirable to obtain information for the purposes of this Commission, and to inquire into the same, and every part thereof, by all other lawful ways and means whatsoever.

AND We do further by these Presents give and grant unto you, or any one or more of you, full power and authority, where the same shall appear to you, or any one or more of you, to be requisite, to administer an oath or oaths to any person or persons whomsoever to be examined before you, or any one or more of you, touching or concerning the premises.

AND Our further Will and Pleasure is that you, or any five or more of you, upon due examination of the premises, do and shall report to Us in writing, under your hands and seals, your observations as to what you shall find touching or concerning the premises upon the said Inquiry; and also your opinions as to the amendment, if any, of any of the existing Laws having reference to the objects of this Commission.

AND We further will and command, and by these Presents ordain, that this Our Commission shall continue in full force and virtue, and that you our Commissioners shall and may from time to time proceed in the execution thereof, and of every matter and thing therein contained, although the same be not continued from time to time by adjournment.

AND We do hereby direct and appoint that you, or any five or more of you, may have liberty, should you deem it expedient, to Report to Us your several Proceedings under this Commission from time to time, as the same shall be respectively completed and perfected.

IN WITNESS whereof We have caused these Our Letters to be made Patent. WITNESS Ourself at Westminster the Fifth day of April, in the Eighth Year of Our Reign.

By Writ of Privy Seal.

EDMUNDS.

SECOND REPORT.

TO THE QUEEN'S MOST EXCELLENT MAJESTY:—

MAY IT PLEASE YOUR MAJESTY—

WE, the undersigned Commissioners, appointed by Your Majesty to inquire into the state and condition of the Tidal and other Harbours, Shores, and Navigable Rivers of Great Britain and Ireland, humbly beg leave to make this Second Report of our proceedings in the execution of Your Majesty's Commission.

In our former Report we confined ourselves to a few specific cases bearing directly on the general question under consideration, and we adduced in proof some examples of the deterioration of the ports of the kingdom from neglect; of their impending ruin from encroachments; of the wasteful expenditure of money from want of sufficient control; and of the necessity of immediate legislative measures in order to stop these and other daily increasing evils to navigation. We then briefly recited the present state of the law with respect to the conservancy of harbours and rivers, showing that the jurisdiction of the Admiralty has, by various Charters and Acts of Parliament, been superseded, to the great detriment of the public service. And, lastly, we ventured to lay before Your Majesty a few recommendations which appeared to us best calculated to meet the evils in question.

A more extended inquiry has fully confirmed the views which the limited examination of last year led us to submit to Your Majesty. Not only is there a general want of control over the management and revenue of the ports, but there is not a single exception among the numerous cases which have come before us in which such a control might not have been the means of saving unnecessary outlay; of preventing encroachments that can now scarcely be remedied; or of stopping works that must be removed in order to secure the objects to which the attention of the Commission is directed.

The necessity of such supervision has also become more apparent since the publication of the Returns to the Orders of the House of Commons of August last, from which we learn that the income of the various ports of the United Kingdom considerably exceeds the sum of 800,000*l.* a-year—the whole levied by Charters and Acts of Parliament, or otherwise, from dues on shipping, and on goods borne by shipping, but over the expenditure of which Parliament has not at present the slightest control.

That much of this money has been and is misapplied will excite no surprise when we find that several harbours are governed by numerous, self-elected, irresponsible commissioners, (in some places exceeding even one hundred in number,) often conducting their proceedings in private, auditing their own accounts, publishing no statement of income or expenditure, and laying out large sums of money without the advice of an engineer; and that these commissioners are frequently landed proprietors, sometimes non-resident, with occasionally a shipowner, but rarely a sailor among them. Such, however, is the constitution of many of the harbour boards of this country acting under authority conferred by Parliament.

Since the date of our First Report, we have, in compliance with that clause of

Your Majesty's Commission, which directs us to visit and personally inspect all the harbours and shores of the United Kingdom, examined the chief ports on the East Coast of England from the river Thames to the Tyne, thus including Yarmouth, Hull, and the principal coal ports of Durham and Northumberland, which, owing to the extraordinary increase in steam navigation, are daily rising into greater importance.

On the West Coast we have personally inspected the rivers Lune, Wyre, Ribble, and Dee; and the ports of the Isle of Man, which, although of small extent as harbours, become of consequence from their position in the centre of the Irish Channel, and as the head-quarters of an extensive and increasing fishing trade.

In Ireland we have been enabled to visit most of the ports and fishing piers around the coast, and have been strongly impressed by a sense of the great value of its natural harbours, their depth and capacity, and the extent and capability for improvement of its fisheries, which even in their present state, and with the fishery piers often in ruins from neglect, afford employment to 19,880 vessels and boats, and 93,000 hardy fishermen.

But these natural advantages are very far from having been turned to the best account; on the contrary, a detailed examination into the state of the principal ports shows that although much has been done, and in many cases, at a heavy expenditure of money, yet that if the works had been planned with a little more foresight, and steadily carried on under efficient control, the same expenditure would have led to far better results, and might have removed the causes of complaint for which there is but too much foundation.

App. B., Ev. p. 1. The harbour of Dublin and the river Liffey offer an instructive example of the correctness of these statements. Within the last thirty years many improvements have taken place; the depth of water over the bar and up to the city quays has been increased several feet, by dredging and by the bold measure of running out the great north wall; the traffic and consequent revenue of the port have more than doubled; and the latter has risen to 34,000*l*. a-year. Yet the evidence shows that the foundation of the quays is generally so imperfect that they will not in their present state admit of the river being further deepened; that the south quay, the resort of three-fourths of the shipping of the port, is encumbered at its foot by heaps of mud; that the entrance into the Grand Canal Docks is all but blocked up by sand-banks; that there is a great want of graving docks; that there is but one public crane; that the port charges are very high; and that the ballast, of which, by Act of Parliament, the Ballast Office has a monopoly, and for which it charges about double the market price, is in many cases bad.

App. B., Ev. p. 46. Wexford harbour, which, from its capabilities, its position in a rich country amidst an industrious population, and its vicinity to the English coast, ought to be one of the most prosperous in Ireland, is the resort of little more than coasting vessels. It appears in evidence that here are 104 harbour Commissioners; that the stream of the Slaney, and the tidal waters of its vast estuary, are left uncontrolled; that the heads of the piles on which the quays are founded project some feet into the river, and have caused damage to several vessels; that a vexatious toll is levied on all vessels passing through Wexford Bridge; and that heaps of stone, now forming an artificial bar eight feet high, have been thrown in at the foot of its piers to save the foundation from being swept away. Similar neglect appears outside the harbour, where the want of a light off Blackwater Bank, and the absence of beacons on the other dangerous sands which line this coast, are stated to have been the cause of several shipwrecks, and of a great sacrifice of life.

App. B., Ev. p. 89. At Waterford, a capacious natural harbour, considerable exertion has been made to deepen the Ford and obtain a channel up to the town; but an extensive mudbank still lines the foot of the finest range of quays in the United Kingdom; the soil, dredged up in one part of the harbour, is dropped into the stream in another; thousands of tons of refuse stone are annually swept into the river from the quarries at Granagh; while the bridge, with its 36 arches and corresponding piers, and an opening for ships only ten yards wide, places a bar to the extension of navigation and improvement towards Carrick-on-Suir and Clonmel.

The celebrated harbour of Cork stands pre-eminent for capacity and safety, App. B., Ev. p. 107. even in that country of fine natural harbours. The upper portion of it, which falls more immediately within the limits of this Commission, extends for five miles below the city to Passage. This part, since the year 1820, has been considerably deepened; vessels of 500 tons now come up to the city, and the traffic and income of the port have proportionably increased; yet the harbour is far from being in that state which a revenue of 8000*l.* a-year for the last 25 years would warrant. Complaints are made that banks at the foot of the quays cause great risk to the fine steamers which ply between the city and Cove; that seven weirs cross the river Lee within 1½ miles of Cork, and impede the upward flow of the tide; that a wall has been built for 1500 yards in a doubtful direction to guide the set of the current, and is now left in an unfinished state; that the silt dredged up from the channel is laid at the back of this wall, and washed down again into the river by every high tide; and that an area of 150 acres, over which the tides used to flow, has been partly enclosed, whereby a large portion of tidal water is excluded. Yet this large space, if enclosed by a wall properly directed, and the loss of the excluded water compensated by dredging the upper part of the bed of the river, might be a benefit to navigation, and form a park for air and exercise for the citizens, instead of being left as a nuisance; in short, to quote the words of a highly respectable witness, "the harbour of Cork has throughout been the victim of half measures."

Complaints also are made that the Glanmire and Ballinacurra rivers are both in App. B., No. 72. a neglected state, while the latter has largely contributed to the Cork Harbour Fund; that a portion of the dues collected in Cork never reach the hands of the treasurer; and that money has been borrowed, and consequently a debt incurred, without the authority of an Act of Parliament.

Surveyors and sailors complain of the too great elevation and ill chosen App. B., No. 73. position of Cape Clear Light; of the want of a light on the Foze Rock, the western point of Ireland; and that there is no coast light from the Old Head of Kinsale to the Hook of Waterford, a distance of 70 miles.

Limerick, at the head of the estuary of the Shannon, the noblest river in App. B., Ev. p. 130. the kingdom, and now, by the energy of the Board of Public Works, rendered navigable almost throughout its whole length, offers great facility for navigation and commercial enterprise. Here there is a magnificent bridge, built across the harbour at a cost of 85,000*l.*; yet, although the same Act under 4 Geo. IV., c. 94. which it was erected expressly gives powers for the construction of floating docks, the harbour still remains without a dock or place of shelter, and vessels at low water lie on the rocky bottom, and exposed to damage; while its income of 4000*l.* a-year, levied upon shipping, is mortgaged to pay the interest of money chiefly expended in building the bridge. It is also stated in evidence that while more than half a million of money has been laid out in improving the Upper Shannon, the estuary of that river, from Limerick to the sea, has been denied even a few hundred pounds to buoy and beacon the dangerous shoals which, although easily removed, are allowed to remain, and obstruct the navigation of the port.

At Galway, similarly situated at the head of a large inlet on the Western Coast, App. B., Ev. p. 145. sheltered from the Atlantic swell by the natural breakwater of the Arran Isles, and shortly to be connected inland with the extensive navigation of Loughs Corrib and Mask; much spirit and enterprise have been shown since 1832 in making a floating dock of 5 acres in extent, fit to contain vessels of 500 tons; in consequence the trade has increased, and the revenue of the port has risen from 340*l.* to 2000*l.* per annum. Yet unhappily the whole of this income is mortgaged to pay the interest of the debt incurred; and, owing to some mismanagement, a rocky bar of three feet high, on which a vessel might break her back, has been left just without the sill of the dock gates. It is also stated that great inconvenience arises from the distance the Claddagh fishermen have to go to their fishing grounds, 30 miles off, and that a pier half way down the bay would be a great boon to this valuable body of men, as well as to the owners of numerous turf boats which trade in this direction.

App. B, Ev. p. 152. Sligo, with limited means, has recently extended its quays 700 yards, and removed a portion of the Blennick Point, while its trade has much increased. Private quays, however, still cause great inconvenience; weirs exist, which obstruct the upward flow of the tide; the ebb and flood stream require to be directed to prevent the increase of sand-banks; and the channel generally wants to be deepened, to enable the port to keep pace with its thriving trade.

App. B., Ev. p 167. Londonderry, on the Foyle, where the river expands into a spacious navigable estuary, has great natural advantages, which have been ill-seconded by art. Mud banks encumber the foot of the quays, which might be kept free by simply guiding the course of the stream. The quays, chiefly private property, are in a neglected state, and project apparently as the owners think fit into the river. Complaints are made by sailors and pilots of the leading lights on Innishowen Head being on the same level, of the want of a light on Rathlin Island, and of the more glaring want of a beacon on the Carrigh-vanan Rock, which lies in the fair track of steamers to and from the port.

App. B., Ev. p. 177. Belfast, the first town in Ireland in enterprise and commercial prosperity, ranks second only to Dublin as a port, and has an income of 22,000*l.* a-year. In the year 1840, a new channel up to the town was opened, having nine feet water at low tides, which has proved to be a great convenience to the fine steamers that daily run from hence to Glasgow and Liverpool. But even with this channel, the improvements in the harbour are far from having kept pace with the rapid advance of the town. Until very lately, the quays and docks have been private property, and thus have been permitted to oppose a barrier to improvement. The evidence shows that they are still in a very neglected state, and that there is so great a want of accommodation, that steamers are often obliged to discharge their cargoes lying alongside the quays three abreast. Complaints are made of the state of the Custom-house; that the lower lock of the Lagan navigation is only a mile and a-half above the town, and thus prevents the upward flow of the tide; that encroachments are making on the banks of the river, and that still more extensive encroachments are threatened by railway speculation: in short, that everything points to the vigilant control which is absolutely necessary to enable this fine port to keep pace with the rapid strides, both in manufactures and trade, of the capital of Ulster.

App. B., Ev. p. 218. Newry has the great advantage of lying within Carlingford Lough, which at a moderate outlay might be made a harbour of refuge, an inestimable boon on this part of the coast. The Navigation Company here, instead of deepening the natural channel of the river, have embarked all their capital in an artificial canal.

Dundalk has recently made great efforts, guided by a skilful engineer, to improve the harbour, and the increase in steam traffic, consequent upon deepening the channel, already demands leading lights at the entrance of the river.

Drogheda has been much improved by steadily dredging the river Boyne, and the revenue of the port has been more than doubled during the last few years; there is, however, much yet to be done, and there are various symptoms of neglect that would vanish under efficient control: like Galway, its whole dues are mortgaged for a debt incurred in improving the harbour.

App. B., Nos. 16, 57, 103. The Piers or Breakwaters of the artificial harbours of Kingstown, Howth, Donaghadee, Dunmore, Ardglass, and Portrush,—all built according to the same mode, of rubble stone, with a long slope to seaward, have all suffered very material damage from the effects of the waves: Ardglass pier, together with its lighthouse, now lies a mass of ruins in the sea.

Irish Fisheries, 1st Report, 1836. Of the 70 fishing piers, constructed or repaired in 1822 and since, at a cost of 43,000*l.*, chiefly of public money, many of them, from neglect in receiving timely repairs, are falling to decay; and one of them, at Newcastle, county of Down, has been entirely destroyed, to the great distress and almost ruin of the fishermen around. These piers have nevertheless proved highly beneficial to the districts in which they are placed, as have also the harbours built by the liberality of individuals, as the Earl of Courtown, at Courtown, Lord Annesley, at Newcastle, Mr. Ogilvie, at Ardglass, and Viscount Palmerston, at Mullaghmore in Sligo; and it is earnestly to be hoped that some efforts will be made to preserve them from a similar fate.

App. B., Ev. p. 236.

To the numerous instances of neglect which we have already cited, we must add, that ballast and stone are very generally thrown over into the harbours with impunity. Bantry Harbour, on the west coast, and Skerries on the east, are two of the most glaring cases: at the latter, it appears in evidence, that 2,000 tons are annually discharged, a great part of which is thrown into the harbour or the roadstead. But even worse than this is the complaint of the pilots, that at Larne—a secure and capacious natural inlet on the east coast—the limestone-boats, after loading at the quarries as deep as they can swim in order to swell their bills of lading, drop down by night to the entrance of the harbour, and there throw over the upper part of their cargo before they venture to proceed to sea.

App. B., Ev. p. 239.

App. B., Nos. 121, 122.

For further details respecting the harbours of Ireland, we humbly beg leave to refer to the Appendix for the evidence taken at each place, to the various Engineers' and other Reports, and to the detailed Reports of the Examining Commissioners on each harbour that was visited. The mass of information on the ports in that part of your Majesty's dominions we believe to be greater than ever before collected, and we feel assured that it will lead to immediate and vigorous measures for their preservation and improvement.

Appendix A.

We must not omit to mention the assistance we received in the course of our examination from the Admiralty Surveyors, and from the Coast Guard around the coasts of Ireland; as well as from the Ordnance Map Office, and the Board of Public Works in Dublin. We have also to acknowledge the great advantage we have derived from the Ordnance maps and Admiralty charts of Ireland; from the accurate lines of level carried across the country by the officers of the Royal Engineers under Colonel Colby, a system which we hope may be extended to England; and from the series of tidal observations discussed by Mr. Airy, in the Philosophical Transactions for 1845, from which a datum is at once obtained for tide scales, to be hereafter established in the ports, or on other points of the coasts of Ireland.

The Isle of Man occupies an important position in the Irish Channel, directly in the track of communication between Liverpool, Glasgow and Belfast, and of the coal trade from Whitehaven and Maryport to the whole of the east coast of Ireland. It has been aptly termed the "Beacon of the Irish Sea," and as such everything that care and skill can suggest, as to lights, beacons and improvement of its harbours, would be well bestowed, and tend to prevent the recurrence of the numerous wrecks that have taken place around its shores. Yet such is far from being now the case; on the contrary (with the exception of the coast lights maintained by the Board in Scotland), marked neglect prevails throughout; and here the evils of irresponsible, self-elected authority are but too manifest, the Commissioners meeting only once a-year to go through the form of auditing their own accounts, keeping no regular minutes of their proceedings, and practically leaving the whole power and authority in the hands of a single person.

App. B., Ev. p. 243.

On the north-west coast of England, the river Lune and the port of Lancaster are capable of much improvement. The recent Admiralty survey of this district has shown that there is a deep-water channel, hitherto neglected, in Morecambe Bay, approaching to within three miles of Lancaster, which, if properly lighted and buoyed, would afford a harbour of refuge—the great want on this part of the coast, where all are tidal harbours.

App. B., Ev. p. 270.

Fleetwood-on-Wyre, from its connexion with the Preston and London Railway, and from its direct communication with Belfast and Glasgow, has at once

App. B., Ev. p. 281.

become a port of consequence; and the admirable system of lighting adopted in its channel, its extent of quay accommodation, and its well-appointed and powerful steamers, offer an instructive example of what well-directed skill and energy can accomplish in a few years.

App. B., Ev. p. 285.

The river Ribble and port of Preston offer a proof also of the value of skilful engineering, as applied to navigable rivers. Only five years since, spring tides rose but six feet, and neap tides not at all at Preston Quay, so that vessels were obliged to unload their cargoes at Lytham, near the mouth of the river, and send them up to Preston in lighters or flats drawing but six feet water; whereas, now, by means of straightening the channel and deepening its bed, spring tides rise ten feet, and vessels of 200 tons, drawing eleven feet water, come up to the Quay. Thus judicious enterprise has much increased the number of its shipping, as well as the amount of its revenue, and enabled the port in some measure to keep pace with the rapid advance of manufactures in the town.

App. B., Ev. p. 292.
17 Geo. II., c. 28, § 16.
17 Geo. II., c. 28, § 19.
App. B., Ev. p. 293.
1st Report, Q. 1759.

The river Dee and the port of Chester afford a striking example of the danger to which the interests of navigation may be exposed by placing the power over the river in the hands of a joint-stock company, whose principal interest consisted in the successful reclaiming of land. The area of the estuary of the Dee, between Chester and Kelsterton, was formerly about 12,000 acres, covered at every spring tide; of this space 8000 acres have been enclosed or, as it is termed, reclaimed, and the tidal water excluded; about 5000 acres of the land thus obtained on the Cheshire side, now form the Dee Company's estate, and nearly 3000 acres on the Flintshire shore are the property of the adjoining landed proprietors. The Act of Parliament that sanctioned this extensive encroachment required that a depth of 15 feet at ordinary spring tides should be maintained up to Chester, in default of which the rental of the company was liable to be seized and applied to the improvement of the navigation. This condition, it appears in evidence, has not been complied with; the standard by which it should be ascertained and which was required to be maintained does not exist, and the river was in so bad a state, in December 1844, that a vessel drawing only 8½ feet water could not go up to Chester on a spring tide.

It appears also that a rubble-stone dyke or embankment extends seven miles along the Cheshire side of the river, "on a line the most injudiciously laid out with regard to navigation;" that this dyke, a portion of which is covered at half-tide, is only marked by insignificant perches or beacons; that several vessels have struck on it, some of which have been entirely lost; that the river, from Flint upwards, is neither lighted nor buoyed; that a weir or mill-dam rising eleven feet above the bed of the river, exists just above the city, dams the water up for several miles, and prevents the upward flood of the tide; that loads of stones are thrown into the river to secure the foot of the jetties; and that at Parkgate, 12 miles below Chester, which formerly was one of the principal mail-packet stations between England and Ireland, a dry sand now extends almost across the estuary.

6 Geo. II., c. 30, § 11.

We abstain from comment on such a state of things, and it is only necessary to add, that the Act of Parliament appointed commissioners, selected out of the neighbouring landed proprietors and citizens of Chester, to see that the Dee Company fulfilled their engagements.

App. B., Ev. p. 320.
App. B., Ev. p. 322.

On the south coast, at Salcombe, there are neither pilots nor a harbour master. At Dartmouth, a small but deep-water harbour, there is neither buoy nor beacon to mark the shoals, nor a light worthy of the name, while two-thirds of the income are applied to corporation purposes. At Exeter loud complaints are made that the South Devon Railway is carried round the coast, although the inland line would be five miles shorter; that it has materially diminished the estuary of the Exe, excluding the tidal water; that it has cut off from all free communication with the sea the bathing towns of Dawlish and Teignmouth, and that in many parts it is carried even below high-water mark; that the prospects of the fishermen in that neighbourhood are thereby absolutely ruined, and that should a vessel be wrecked there in an on-shore gale, no boat or raft can possibly reach the shore.

On the north-east coast, the river Tyne and port of Newcastle, including North and South Shields, take the lead among the principal coal ports of the kingdom, which, owing to the vast increase in steam navigation, are daily rising into greater importance. Newcastle has shipped upwards of two millions of tons of coal per annum for the last quarter of a century; her foreign trade has risen to App. B., Ev. p. 325. half a million tons yearly, and the revenue derived from the river and paid to the City Corporation, who by charter are conservators of the port, amounts to 19,000*l.* a-year, exclusive of 6000*l.* annually levied by the Trinity Board for primage, buoyage, &c. Where all seems so prosperous, it is an ungrateful task to point out that such a state of things may be deceitful; yet so it assuredly will prove to be on the Tyne if the river be much longer abandoned to itself, as, generally speaking, it has been till within the last few years. The improvements proposed by Mr. Rennie thirty years since have, with the exception of a quay at Newcastle, been left unexecuted; the width of the river remains extremely irregular. in some places the channel being only 60 yards wide; sharp angles increase the difficulty of navigation; upwards of 80 acres of sandbank, dry at low water, still disfigure the bed of the stream; Newcastle Bridge, with its 9 narrow arches, heavy piers and additional starlings, acts almost as a mill-dam; a loss of five feet range of tide, in the distance of about twice as many miles, takes place between Tyne Bar and Newcastle Quays; coal staiths are projected irregularly into the stream; and no dock accommodation has been provided, while Shields Harbour, the daily resort of hundreds of colliers, is so inconveniently crowded that damage frequently App. B., Ev. p. 328. occurs.

Sunderland is indebted less to nature and more to art than the neighbouring App. B., Ev. p. 349. port of Newcastle; here extensive stone piers project into the sea, by the aid of which several feet of water over the bar have been obtained, and the enterprise of the coal-owner and ship-builder, and the skill of the engineer, have been rewarded by a revenue of 16,000*l.* a-year, derived from an extensive home-trade in coals, and a rapidly increasing foreign traffic. This port, however, is capable of much improvement; the quays are private property, and much out of order; the moorings were so indifferent, that owing to the pressure of the ice, in the winter of 1841, the whole of the shipping in the harbour broke adrift, and the damage done was estimated at 80,000*l.*; the foundation of a part of the south pier is so insecure that the scouring of the sea has undermined its foot; the entrance of the north docks is far from being well placed; so heavy a swell ranges along the piers, and into the harbour, that the engineer has been obliged to take down a large portion of the middle of the south pier in order to make a beaching place for the swell to expend itself upon; and a general complaint is made of the want of dock accommodation, affording an easy outlet to the southward in north-easterly winds.

Hartlepool owes its rapid rise chiefly to its southern outlet, the want of which is so much felt at Sunderland. This fortunate position has been in some measure seconded by the Dock and Railway Company, who have now a floating dock App. B., Ev. p. 357. of 20 acres, where they can load 5000 tons of coal a-day; while the entrance is allowed to be one of the most easily accessible of any of the tidal harbours along this coast. The success of this port has induced the formation of a Hartlepool West Harbour Dock, about half a mile to the westward, the works of which are in an advanced state. But as it is hardly to be expected that two rival companies in the same port should agree upon any general plan for improvement, some independent control, free from local bias, seems to be absolutely essential. Complaints are made of ballast and stone being thrown over the cliff and washed into the harbour; that the bight of the bay is filling up with mud and silt, caused by sluicing out of the Slake, and the fishermen with one voice declare 2 Geo IV, c. 67. their fishing ground has been thereby destroyed.

Stockton-on-Tees, including Middleshrough, is one of the most thriving of our coal ports. The channel of the river has been contracted and deepened; the App. B., Ev. p. 361. approaches are admirably lighted; a floating dock of nine acres has recently been opened at Middleshrough; the traffic and revenue of the port have doubled within these few years, and in 1845 the Darlington Railway Company leased the whole of the harbour dues, and declared it a free port. All is bustle and activity, and all seems to prosper. Yet even here, on a closer inspection, the want of some control is manifest—the quays are nearly all private, and are falling into the river; the piers of the bridge are only supported by the loads of stone thrown down at their foot; rocks of whinstone impede the upper navigation, and cause damage to the barges; the entrance of the dock at Middlesbrough, completed but five years since, is only thirty feet wide; while about 2000 acres of the estuary have been enclosed, and the corresponding tidal water excluded; and the channel over the bar, which formerly ran out due east, has, in consequence, changed to N.N.E. Great complaints also are made of the want of a harbour of refuge in the neighbourhood, and of a beacon on Redcar Rock, upon which vessels are annually wrecked.

App. B., Ev. p. 372. Whitby has a revenue of 3,600*l.* a-year, derived from a passing toll on coal borne by shipping, specially imposed "for the improvement of the harbour." It offers to shipping, in return, a west pier, of fine Whitby stone not placed in the best direction, which projects 100 yards beyond the east pier, and causes an eddy at the entrance; a circular head, inviting the run of the sea into the harbour; an entrance one-third too wide; a rocky bar, that might easily be blasted, on which more than one ship has broken her back; a mill-dam that stops the upward flow of the tide; a railway dam, recently made, which excludes 30,000 cubic yards of water on every spring tide; ballast and the rubbish of the town thrown below high-water mark and behind the west pier; and a dry harbour.

1st Report, p. 181.

App. B., Ev. p. 381. Scarborough, for some unexplained reason, has been denied the passing toll that has been continued to Whitby and Bridlington, immediately adjacent. The limited funds at the disposal of the trustees have been recently applied in deepening the eastern harbour, and in erecting a self-registering tide-gauge at the pier end. This is the first instance, on this part of the coast, of proper attention to the phenomena of the tides, on which most of these harbours are dependent for their existence, and it is an example well worthy of imitation by the more wealthy neighbouring ports.

App. B., Ev. p. 389. Bridlington, like Whitby, has enjoyed a passing toll on coals for the last 150 years; like Whitby, too, it offers in return a harbour dry at low water; a north pier, built with public money at a very great cost, yet not even carried out to low water; no quay accommodation; a heavy range of swell along the pier, so that no moorings will hold the vessels; and a pier-end light furnished with a single candle; yet Bridlington Bay is the only good shelter in northerly gales on this coast; and in a continuance of such winds, 300 vessels may be seen lying here under shelter of the Smithwick Sand, which helps materially to break the sea, and offers an admirable foundation for a breakwater, the construction of which would supply the great want of this part of the coast, by making a harbour of refuge of Bridlington Bay.

App. B., Ev. p. 397. Kingstou-upon-Hull takes the lead as the first port in the kingdom for inland trade; while its position with respect to the North Sea has made it the chief outlet of our manufactures to Northern Europe, and raised it to the rank of the third port in the country in foreign traffic. The approaches by the deep but intricate channel of the Humber are admirably buoyed and lighted by the Hull Trinity Board; floating docks to the extent of 23 acres already exist, and 15 acres in addition will soon be opened. The activity at the docks is not surpassed by that of any other port in the kingdom, 75 vessels having lately passed through the Humber Dock lock in a single tide. The tonnage of the vessels that have paid dock dues during the past year amounted to 700,000 tons, and the whole income of the port, derived from tolls on shipping and goods borne by shipping, exceeds 75,000*l.* a-year.

Commercially important as Hull appears to have been in the infancy of British commerce, it was not till 1775, that the old Hull Dock was set on foot; the traffic still increasing, the Humber Dock was begun in 1807; more than twenty years elapsed, during which the trade almost doubled, when the Junction Dock was opened in 1829, but not until Goole had been declared a bonding port. Great as was the increase of accommodation thus afforded, the trade more than kept pace with it; and as it appears in evidence, for want of dock room ships have been greatly damaged, and some sunk in the harbour from its over-crowded state, being at times so full that vessels could not get in or out for weeks together; and on one occasion, a vessel made a voyage to the Baltic and back, while another ready for sea at the same time was endeavouring to proceed down the harbour. Thus Hull affords a striking instance of the evil of permitting a company levying heavy dues on shipping, to obtain power to give or withhold dock accommodation according to its interests, instead of this power being vested in the Corporation or in Trustees for the public good. The original shares of the Dock Company, on which 250*l.* only have been paid, are now worth 2000*l.*

App. B., Ev. p. 402.

It is further stated in evidence, that the Dock Company levy tolls on vessels entering the old harbour, although making no use of the docks, and yet refuse to bear their share of the expense of cleansing that harbour, from which they derive a revenue exceeding 2000*l.* a-year; that the Junction Dock sill is laid five feet higher than the Humber Dock in connexion with it, causing great detention and expense to loaded vessels; that the jetties of the Humber Dock have been carried out beyond low-water mark, whereby an irregular line of fore-shore has been made, and the mud allowed to accumulate in large quantities; that the Ferry-boat Dock is full of mud; that very recently vessels have been damaged by grounding upon a bank in the Dock Basin; and that 100,000 tons of mud, taken from the docks, are annually deposited in the river, in some cases on a flowing tide, and within 160 yards of the face of the town.

Complaints are made, too, that during the last 20 years upwards of 50,000*l.* have been spent by the town in contesting the Dock Company's Bills in Parliament; that the old Haven is in a highly dangerous state, having banks, piles, and heaps of stone rising 17 feet above the bed of the river, all parties denying their responsibility to cleanse it; that a cranch or hard bank of rubbish from the neighbouring manufactories and ship-yards is formed at its entrance; that the Hull and Selby Railroad, running along the northern shore of the Humber, has interposed a barrier between it and much ground valuable for ship-building, engineering works, and manufacturing purposes; and that, in fact, the whole of the port is without any guardian power.

App. B., Ev. p. 424.

Grimsby, from its position near the entrance of the Humber, will, when the proposed extensive works are carried out and the projected railways completed, offer great facilities to the trade with the Baltic and Northern Europe; it will be a ready coaling place for steamers, and will probably become the principal resort of the fishing vessels employed on the Dogger Bank, as well as on the more distant grounds of the North Sea fishery. This part of the Humber and the neighbouring anchorage of Hawk Road offer the only Harbour of Refuge in easterly gales, from Harwich to the Firth of Forth; and during these winds 300 vessels have taken shelter here at one time. Every interference, therefore, with the set of the tides, or any removal of shingle, which may endanger Spurn Point at the entrance of the river, should be most jealously watched and guarded against.

App. B., Ev. p. 472.

Great Yarmouth is of importance for its commerce and fisheries; and its roadstead is well known as the most capacious in England, and as a great thoroughfare and shelter for the coasting trade. Yarmouth Haven has a depth of 8 feet on the bar at low water, and vessels of from 13 to 14 feet draught enter at ordinary high tide. The registered tonnage of the port is 46,700 tons, and the number of arrivals yearly about 3000 vessels, the aggregate tonnage of which amounts to 176,828 tons.

The depth of the harbour has been increased three or four feet during the last nine years, and it appears to be capable of much greater improvement. Its revenue in 1836 was 8052*l.*, and in 1845 12,495*l.*, showing an increase of 4442*l.* The total amount of harbour dues collected since the passing of the Act in 1835 amounts to 102,970*l.*, the greater part of which has been expended by the pier-master, under the direction of the Commissioners, without the advice of an engineer; and yet the accommodation of the harbour is insufficient for the trade of the port.

The tide flows 30 miles above Yarmouth by three separate rivers, affording great command of back-water; yet the free entrance to these ample reservoirs has been neglected and impeded, and thus Yarmouth has been deprived of a great portion of the benefit of that back-water, the action of which, it is generally admitted, would still further have improved both the harbour and the bar.

One great impediment to the flow of the tide is the narrowness of Yarmouth

Bridge, and of the adjoining part of the haven, which occasions in ordinary tides a difference in the height of the water of one foot, and in very high tides of from three to four feet, between the bridge and the pier head.

App. B., Ev. p. 507. Norwich, a city containing 62,344 inhabitants, situated in the centre of the county of Norfolk, and distant 30 miles by water from the sea, was constituted a port by the opening of the Lowestoft navigation in 1832. Its exports and imports being large, its citizens had long desired a direct communication with the sea by the port of Yarmouth; and the river Yare, throughout its whole course from Norwich to its junction with the Breydon Water, being of sufficient depth to admit vessels of 200 tons burthen, the Burgh Flats and the narrowness of the Yarmouth Bridge were, and still are, the only impediments to that desirable object; but these portions of the navigation were then intrusted to the charge of the corporation of the town of Yarmouth, who refused the citizens of Norwich the desired communication with the sea. Thus thwarted, the citizens of Norwich formed a joint-stock company, and applied to Parliament for access to the sea by Lowestoft; but even in that attempt they were opposed by the corporation of Yarmouth, who expended more than 8000*l.* in Parliamentary opposition to their object.

The communication, however, between Norwich and the sea at Lowestoft was obtained; but having failed to realize the expectations of its projectors, there is again a unanimous desire to have a direct navigation to the sea through Yarmouth: but it is stated that there is still the same opposition to this project on the part of the Yarmouth Haven and Pier Commission, now intrusted with the management of the localities referred to, although it is generally admitted that the deepening of the Burgh Flats and the widening of Yarmouth Bridge would not only afford the desired communication, but also tend to the improvement of the harbour and bar at Yarmouth; while, at the same time, the cost of executing the necessary works, to secure these objects, would not greatly exceed the sum mentioned as having been spent in fruitless opposition to the navigation by Lowestoft.

App. B., Ev. p. 522. Lowestoft Harbour was opened in 1832, and when the navigation was first completed, vessels drawing 11 feet water could pass up to Norwich; but a bar has since formed at the entrance of the harbour, and Lake Lothing has considerably silted up, so that, at the present time, vessels of only 5 or 6 feet draught of water can use the navigation.

The works were executed at the large expense of about 150,000*l.*, of which 50,000*l.* was lent by the Exchequer Bill Commissioners, and the annual revenue being insufficient to maintain the works and pay the interest of that loan, the Exchequer Bill Commissioners took possession of the harbour and navigation; and, after retaining it for two years, sold it, with all the powers under the Act, of 1827, for 4,935*l.*

App. B., Ev. p. 516. 1 Wm. IV., c. 50. Beccles, on the Waveney, 26 miles above Yarmouth, was constituted a port under the Act of 1831, which sanctioned its direct communication with the sea, by the opening of the Lowestoft navigation. The river was deepened by the funds received from the Yarmouth Haven and Pier Trust, so as to enable vessels drawing from 7 to 8 feet water to go up from the sea at Lowestoft to Beccles Bridge: but from the silting up of Lowestoft Harbour, only vessels drawing 5 or 6 feet water are able to go up at present.

It is stated that if St. Olave's Bridge were removed from the River Waveney, and the Burgh Flats deepened, sea-borne vessels of much greater draught of water could easily reach Beccles through the port of Yarmouth.

The expense of the Beccles Act of Parliament affords an instance of the unnecessary waste of money resulting from the existing practice of considering navigation Acts as private ones, for the sum of 1,615*l.*, principal and interest, has been paid for its passing through Parliament, while only 16*l.* has been applied to the improvement of the navigation of the river, which was the ostensible purpose for which the Act was obtained.

App. B. Ev. p. 467. Blakeney and Cley, on the north coast of Norfolk, have a common entrance from the sea, which, by a winding course, is distant from the town of Cley $5\frac{3}{4}$, and from Blakeney $3\frac{1}{2}$ miles. Within the memory of some of the present pilots, 140 coasting vessels have taken refuge in this port during one tide; yet in the place where these vessels lay afloat at low water there is now only a depth of 4 or 5 feet, and the utility of the harbour has consequently been almost destroyed.

It is stated that this evil has been caused by the enclosure at different times of more than 1200 acres of land, over which the tidal waters formerly flowed.

57 Geo. III., c. 50.

Unfortunately, also, in 1817, Blakeney, by Act of Parliament, became a proprietary harbour, and the merchants and inhabitants, unless they are proprietors, have no power to interfere in its management, or in the regulation of the charges on the shipping: and until legislative authority be given, no such power can be exercised either by the Government or by any other parties.

App. B., Ev. p. 437.

The port of Wells lies a few miles to the west of Blakeney. The bar of its harbour is dry at low water, but the rise of tide on it at ordinary springs is 21 feet, though at the quay only 12 feet.

The inhabitants struggled for nearly half a century to prevent the enclosure of the tidal lands by the adjoining proprietors, even at the expense of many suits at law; but all these efforts were frustrated, and 846 acres have been enclosed, to the great detriment of the harbour.

The necessity of the supervision of harbours by Government further appears from the fact that, under an Act passed so recently as 1844, the sum of 9650*l.* has been borrowed, on an assignment of the harbour dues, to erect a quay; and the expenditure of this large amount has been left almost entirely under the control of one of the Commissioners, who acts as secretary, collector, treasurer, paymaster, and superintendent of the steam-tug and of all public works; and who thus has the whole management of the works and finances, without even the check that would be afforded by the assistance of a clerk or the employment of a practical engineer.

The merchants and inhabitants complain of the heavy burdens imposed on them by such gross mismanagement; but, as in many similar cases, they have no power to interfere or obtain redress, as the Commissioners named in the Act, who now permit such mismanagement, and many of whom do not even possess any property in the town, have the power of nominating others to fill up vacancies.

App. B., Ev. p. 535.

At Harwich, besides the extension of Landguard Point mentioned in our former Report, it appears that, owing to the continued excavation of cement stone near the coast, the sea has made great inroads in Mill Bay to the westward, and at Felixstow to the eastward, and the Admiralty surveyor has recently reported that the waves are encroaching to a great extent along Landguard East Beach, at the rate of five-and-twenty feet a-year. Unless some decisive and systematic plan of groyning in order to repel this encroachment be at once adopted, it is impossible to predict what mischief may arise to this valuable harbour.

Harwich also offers an instance of the necessity of again defining the limits of ports, as the Corporation of Ipswich claims by charter, and daily exercises the right of levying anchorage dues upon vessels lying close to the face of the town of Harwich, and manifestly far removed from the natural limit of the port of Ipswich.

Parl. Paper, No. 571, 1845.

App. B., No. 322.

It appears from the Parliamentary Returns that the aggregate debt of the several ports of the United Kingdom, exclusive of docks in the Port of London, exceeds 6,000,000*l.* sterling; one-third part, therefore, of the whole harbour income of 800,000*l.* a-year must be annually appropriated to pay the interest of this debt, which will consequently materially cripple the means for future improvements. This large sum, although borrowed with the sanction of the Legislature, has been laid out entirely by the several local Boards, without the slightest control being exercised over it either by Parliament or by any other power specially charged to watch over the interests of the public.

Parl. Paper, No. 571, 1845.

Among the numerous cases of the misapplication of harbour funds, to which we have already had occasion to refer, the sum of more than 30,000*l.* expended last year in parliamentary and legal expenses connected with Bills for the improvement of Harbours, seems to your Commission to be a most impolitic and unnecessary outlay, and one which might be entirely prevented by the establishment of a Harbour Conservancy Board, such as we have humbly ventured to submit for Your Majesty's consideration.

From the competition already commenced between railroads and the coasting shipping, we fear that unless immediate measures be taken to improve the harbours and navigable rivers of this kingdom, and, where practicable, to lessen the dues, a large portion of the goods which these vessels now carry will soon be conveyed by the railroads rapidly extending to almost every part of the coast. We would, therefore, strongly urge such assistance, not only on economical but on political grounds of the highest importance to the maritime interests of the kingdom, as the coasting trade has ever been the best nursery for the hardy race of seamen who have so ably maintained the honour and power of the country.

1st Report, p. xi. We alluded, in our First Report, to the obstructions and shoals which so seriously impede and endanger the navigation of the Thames, between Gravesend and London Bridge; all the additional information and evidence we have received since that Report was presented fully convince us of the correctness of the opinions we then expressed, and we feel confident that, if the various and frequently conflicting authorities, to whose guardianship the conservancy of this noble river is intrusted, could be induced to co-operate cordially in its improvement, and to carry on their operations jointly on one sound and uniform system, the impediments which now discredit the local administrations and endanger the commerce of the metropolis, might be speedily and cheaply removed. And in strong corroboration of our own view of this subject, we subjoin the following extract from the Report of a Select Committee of the House of Commons in the year 1836, specially appointed to inquire into the state of the Port of London:—

> "That this Committee are of opinion that the various conflicting jurisdictions and claims of the Admiralty, the Trinity House, and the Corporation of the City of London, over the river Thames below the bridges, have had a most injurious effect upon the interests of navigation; that it is desirable they should be consolidated and vested in some one responsible body, and that means should be found to provide for the removal of shoals and obstructions in the bed of the river."

Evidence, p. 35. And we refer to the evidence of Captain Bullock, R.N., of Mr. James Walker, C.E., of the harbour-masters of the Port of London, and of the pilots whom we have examined, which is given in the Appendix, as well as to the detailed Report on the subject by one of the members of this Commission, in which we entirely concur.

All these facts and considerations induce us most earnestly to repeat the recommendation, which we ventured dutifully to submit to Your Majesty in our former Report, that all the tidal harbours in the United Kingdom be placed under the special care of a Board of Conservancy, to be formed under the authority and provisions of an Act of Parliament (of which we annex a Bill), being fully convinced that any less stringent and decisive measures will be found wholly inadequate for the accomplishment of the great national object which Your Majesty has been graciously pleased to direct us to consider and examine.

All which we humbly certify to Your Majesty.

Wm. BOWLES, Rear-Admiral, M.P., *Chairman.*
J. J. GORDON BREMER, Captain R.N.
JOSEPH HUME, M.P.
AARON CHAPMAN, M.P.
EDWARD R. RICE, M.P.
THOMAS BARING, M.P.
F. BEAUFORT, Hydrographer.
G. B. AIRY, Astronomer Royal.
JOHN WASHINGTON, Captain R.N.
RICHARD GODSON, Q.C. & M.P., Counsel to the Admiralty.

London, 20*th March,* 1846.

MINUTES OF EVIDENCE

TAKEN BEFORE

THE COMMISSIONERS APPOINTED TO INQUIRE INTO THE STATE OF TIDAL HARBOURS.

Wednesday, 16th July, 1845.

Present:—

Rear-Admiral BOWLES, C.B., in the Chair.

Captain Sir GORDON BREMER, K.C.B.	Captain BEAUFORT, R.N.
Mr. HUME, M.P.	Captain WASHINGTON, R.N.

(*Captain Bullock's Chart of the Thames from London Bridge to Sea Reach, in* 20 *Sheets, on the Scale of* 20 *inches to the statute mile, surveyed in the Years* 1831-4, *was laid on the table.*)

Capt. Frederick Bullock, R.N., examined.

Capt. F. Bullock, R.N.

July 16, 1845.

PORT OF LONDON.

1. (*Chairman.*) You are a Captain in the Navy, and one of the Admiralty Surveyors?—Yes.

2. Will you state what parts of the coast of England, rivers, and ports you have surveyed?—The River Thames, Medway, and continued to the Naze of Harwich, and the South Foreland.

3. How long have you been engaged in these particular surveys?—Since 1830.

4. With reference to your survey of the River Thames, will you state to the Commission the different shoals and obstructions to navigation you have found?—I was examined before a Select Committee of the House of Commons, on the 1st of June and the 1st of August, 1836. I also made a report on the 20th of January, 1842, and my opinions are therein fully given on the state of the river, to which I refer the Committee.

5. (Mr. *Hume.*) After the lapse of so much time, have you had an opportunity of re-considering these opinions, and have you any reason to alter them?—None whatever.

6. (*Capt. Beaufort.*) Have any material changes taken place in the river since that time?—On the 28th of April, 1840, on examining the harbour of Woolwich, which embraces the whole of the Dockyard-wall, as may be seen on the plan, I found that the harbour had decreased in depth 4 feet 6 inches since my last examination in 1830-31; and that the low-water line had projected also about 50 feet in that time. In 1844, I also found that these shoals slightly increased and projected from the shore to the Ordinary in that part, and I reported that without artificial means be promptly employed, this useful harbour will cease to be available to other than steam-vessels of a light draught of water.

7. (Mr. *Hume.*) Was anything done in consequence of that Report?—Yes, there was a mud engine employed, and the harbour improved. Still the process of deposit is going on. Wherever I have examined the river I found some increase of deposit.

8. What recommendation did you make?—I said some artificial means should be used in dredging the shoals, and clearing the deposit.

9. Had you in view the cutting off of any portion of Hookness Point?—No, not till a future period.

10. After that did you make any other report of changes?—No.

11. In 1842, were you one of those engaged with Mr. Walker to survey and report on the River Thames?—Yes, and to that report I beg to refer the Committee.

12. What was the principal recommendation you then made?—Embankments throughout the course of the river, with a view of straightening its course, and inducing the ebb and the flood to flow through the same channel.

13. You state in that Report that the velocity of the stream under like circumstances of declivity and pressure depends on its freedom, or, in other words, on its breadth and depth?—Yes.

14. Do you mean by that, that you would embank where portions of the banks of the river are wide, so as to have one uniform course, and deepen the centre channel, to admit a greater water-way to make up for the diminished width?—Yes, in order to preserve its sectional area.

15. Do you concur with Mr. Walker in the opinion he gives of deepening the river from London Bridge downwards, so as to have 12 feet water at low water to Gravesend?—Yes, most cordially.

16. Did you see any difficulty in that being effected on the plan proposed by him of employing dredging machines to remove the shoals?—There is no difficulty whatever; Mr. Walker himself proposed for a certain sum of money, I think for 60,000*l.*, to clear every shoal in the river, and bring it to 12 feet water.

17. (*Chairman.*) To whom was that proposition made?—To the City authorities in Committee.

Capt. F. Bullock,
R.N.

July 16, 1845.

PORT OF LONDON.

18. (Mr. *Hume.*) Do you consider that the deepening of the channel might be made in the way you have stated without detriment to the buildings on either side, or do you suggest any means of preventing injury to them in case of deepening in the centre?—In my Report, I think, that was left entirely to Mr. Walker, but there could be no doubt at all that in deepening from the centre towards the sides there would be some risk to the buildings, but that could be easily remedied by pilings on the sides. An instance of the facility of doing these things is witnessed at any time at the St. Katherine's Docks, where they have deepened to 20 feet at the buoy, and to 8 feet at the wharf, and also at the Brunswick Wharf at Blackwall; the former under the management of Sir John Hall, and the latter by Mr. James Walker, Ex-President, C.E.

19. Making the depth gradually from the centre decrease to the sides?—Yes.

20. Do you consider that might be done equally in every part of the river by the means you have now stated?—Certainly, by dredging in the centre to 12 feet, and decreasing gradually towards the banks.

21. You stated that by the mode of raising ballast, holes are ploughed up in different parts of the river by which the direction of the tide is sometimes made to the injury of other parts of the bank?—It is more particularly so above bridge that I discovered that in dredging the bottom of the river, they screened the soil on board of the vessel, and threw all that was not profitable overboard. Thus converting the river into holes and hills, the hills rising above low-water mark, and the holes being often at the depth of 12 or 14 feet.

22. You suggest in that Report a better mode of dredging ought to be employed so as to remove in the first instance the shoals?—Yes.

23. Do you mean that in any dredging to be employed not only gravel, which can be sold, but silt and peat, and any other rubbish should be removed?—Yes, all material from the shoals should be removed whether it is profitable or not.

24. Would you commence that operation by removing from below, working from Gravesend upwards, or from London Bridge downwards?—From London Bridge downwards; and for this reason, that in the process of removing shoals or raising ballast a portion of the material escapes from the machine and is taken onward by the tide, and while its force continues is held in suspension, but is deposited in the first eddy it reaches; and as every shoal is a determining cause of another further down the stream, it is probable it will only reach the next in succession. In removing the second shoal therefrom, you take away, with it, that which has been recently deposited from the first, and so on to the lowest shallow; the process of dredging is a hazardous expedient, without it is thoroughly and systematically carried out, having always in view uniformity in depth; nor should the clean and deep bed of the river be ever disturbed, it is always mischievous to excavate the centre of a good channel.

25. Is that map which lies before you the one which was prepared by you?—Yes.

26. What time were you employed preparing it?—The whole of it from London Bridge to the Sea Reach cost four years.

27. Are you able from the soundings taken on that map, if now required, to ascertain whether any and what changes have taken place in any particular spot within these limits?—Yes, I am, and the examination would be extremely interesting, since it may be suspected that the removal of old London Bridge will have caused some great changes in the Pools.

28. Do you consider it an improvement connected with navigable rivers generally that that plan should be adopted as the best means of ascertaining the changes that take place?—I know of no other than minute examination, repeated at short intervals.

29. You state in your Report to the Common Council that mischief arises from neglect of the river's beds or banks. What particular mischief do you allude to in that case?—I allude, first, to all shallows. Every shallow in the river is certainly a blot on the conservancy, to whomsoever it may relate, for this evil has been going on for centuries.

30. It is your opinion, then, that one continued system of improvement should be adopted, and that that should be commenced at London Bridge and carried regularly downwards, working principally during the ebbs?—Yes; the same improvements may be carried on above bridge. If they would proceed on that principle, it would be better that they should begin above bridge, because there would be the same danger, if there is any disposition to deposit in the same place; but our plan of a uniform line of embankment throughout is to do away with that disposition.

31. Are you able to state what depth of water could be procured between Woolwich and London Bridge if a proper system of dredging and embanking was employed?—Speaking generally to the depth of the prevailing channel, the depth we recommended was uniformly 12 feet in the centre of the river.

32. Would not that depth throughout the distance stated between the bridges, if obtained, give great accommodation to the smaller craft, such as steamers and others, which now occupy the Pool and places below London Bridge?—Certainly; and the increase of the traffic now requires it.

33. Do you find any difficulty as to soil?—None at all.

34. What is the nature of the soil?—All good and clean, except here and there near the sides, gravel that could be turned to useful purposes. Indeed, I may say, that the City authorities do turn it to account; they sell it for building purposes.

35. Is it your opinion that authority, whatever that authority might be, ought to have the interrupted conservancy of the river with a view to acting on one general plan?—That has always been my opinion.

36. Would not the accommodation above bridge, particularly for the smaller class of steam vessels, relieve the Pool and other parts from much of the inconvenience now suffered?—Decidedly.

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37. You state, that although the Thames is one of the largest commercial rivers in the world, yet, hitherto, it has not had its due share of improvement; what do you allude to?—To the river generally, for until lately, when they have been trying to remove the shoal in Limehouse Reach, the City have never, in my recollection, done anything towards the improvement of the river Thames.

38. Do you consider that science applied to assist nature in this river might produce the benefits you want of clear navigation?—Yes; it is system alone that is required.

39. To assist the natural agencies which you consider to exist at the present moment?—Yes; the agencies of the stream.

40. Have you observed, since you surveyed the river originally, any change produced by jetties or projections for landing in any parts of the river?—Yes; at Gravesend more particularly.

41. What has been the nature of that encroachment?—A shoal rising out of the deep water about 500 feet below the town pier at Gravesend.

42. What is that produced by?—Deposit from the interruption of the pier to the ebb tide producing an eddy.

43. How far has that pier projected into the river?—I think at the time it was a projection 40 feet below low-water mark.

44. That has produced a shoal dry at low water?—Yes, and has a name of reproach; it is called the Little Blythe.

45. Has that a tendency to increase at the present moment?—There is not a doubt of it; it will join on the low-water line below, which it is now doing. The shoal itself, in the first instance, was separated; it is now elongating, and will join on to the low water line, bringing the whole of the shore out.

46. Has the erection of that pier, and the formation of the bank which you have now described, injured the navigation of the river in that part?—To the extent of 40 feet.

47. Have you examined particularly into the cause of Woolwich Harbour, as you have now stated, being filled up?—I think it is attributable to the position of Woolwich Harbour, which lies in a bight or recess of the river, both the ebb and flood tides being deflected from the harbour.

48. How would you remove that?—It could only be removed by great additional work, both above and below the harbour, Gallions' Point below, and Hookness above.

49. Would not the removal of Hookness, opposite Mill Pond, in the way you propose, prevent the annual outlay that is requisite to keep a proper depth of water at Woolwich?—That is my opinion.

50. Consequently, in the end, it would not be any increase of expense to the Government?—It is my opinion, that by bringing the tide through the harbour of Woolwich it would improve it.

51. (*Chairman.*) You mean so as to enable it to scour the front of the dockyard?—Yes.

52. (Mr. *Hume.*) Can you state how far the low-water mark projects from the north, a little below Hookness?—About 160 yards.

53. Are we to understand that the removal of that portion of Hookness above, and also the removal of a portion of Gallions' Point below, comprehending a space of nearly three miles, would prevent that bank which now appears on the north side of the river, and also prevent the silting up on the south side, off Woolwich, immediately in front of the dockyard?—That it would prevent any further deposit I feel assured, but I am not satisfied that it would have any influence upon Ham Shelf, on the north.

54. That is what you have recommended throughout?—Yes.

55. And from what has taken place since that time, you are confirmed in the opinion you then gave?—Yes.

56. Did all the gentlemen who reported at that time concur in that opinion?—All. This is the best line we could contrive.

57. If that was done, you would gain opposite Hookness a considerable portion of the southern bank?—Yes, which might be filled up with what was taken out of the river opposite.

58. So as to lessen the labour of conveying materials?—Yes, and preserve an area.

59. In sounding opposite Woolwich, do you find a gravel bottom, from Hookness down to Woolwich?—Yes, all the way; the upper stratum is gravel.

60. If the channel were straightened and deepened by the removal of that silt, do you believe that at any future period any silt would deposit?—No, that is my reason for recommending it.

61. (*Chairman.*) Then on your proposed plan you would not diminish the breadth of the river, but preserve the sectional area completely?—Yes.

62. (Mr. *Hume.*) As banks end shoals tend to form eddies and additional banks, do you continue of opinion that the piers and jetties, and wharfs, and every encroachment on the waterway, tend to produce the same result?—In a measure, all; and my opinion is that as every inch of the waterway of this great river is available to its commerce at one time of tide or another, that there ought to be no interruption beyond the line we have drawn out and recommended.

63. Do you consider that dredging to obtain gravel, by ploughing up new channels, may disturb and divide, and probably alter the waterway, to the injury of the natural set of the current?—Yes, all interruptions to the stream ought to be removed; indeed unless these are removed there can be no permanent improvement.

64. You have stated that a bank is formed below Gravesend; has that been gradually and imperceptibly forming?—Yes.

65. What deposit of silt do you consider now to have formed?—Six feet, extending 530 feet below the river.

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66. (*Chairman.*) With regard to the tendency of piers to produce any prejudical effect on the river, have you observed the effect of any other erection of piers, besides those below Gravesend?—No, I have not; but I have found from experience that it has always that effect.

67. (Mr. *Hume.*) You state that a current alternately up and down in different channels produces mischief?—I do.

68. How is that done?—By depositing a shoal in the centre. Every middle ground, and there are several, is produced by the irregularity of the flood and the ebb tides.

69. At a particular point?—Yes, in the centre of the river; I refer to middle grounds.

70. What are the general principles you would lay down for the improvement of navigable rivers?—Uniformity of embankment, so as to produce the ebb, and the flood tide to run in the same channel. Vide my Report of 1842

71. A continued stream, and avoiding eddies?—Yes.

72. You have stated that a shoal produces an eddy, with a constant tendency to increase the shoal. What are the effects of making deep holes, either by dredging for ballast or from any other cause?—To produce an eddy. Wherever the force of the current ceases, whatever be the cause, there is a deposit; whatever interrupts the uniform course of the stream, produces an eddy.

73. Then towards the improvement of the Thames, or any other navigable river, having narrowed the wide parts in the banks so as to give an uniform line, what shape would you give to the bottom of the channel?—The segment of a circle, taking the depth of 12 feet at the centre, and gradually diminishing to low-water mark or the edge of the wharf. I give my opinion practically as applicable to the Thames, for preserving the wharfs, and such as I could carry out from London Bridge to Gravesend.

74. (*Chairman.*) With regard to the preservation of the tidal waters of the kingdom, are you of opinion that the establishment of a Board, which should have power to regulate all matters connected with it, would be beneficial?—Yes, of all rivers, especially the River Thames, which is of such consequence to the metropolis, that it becomes a great national question, and should only be undertaken by the Government. It cannot be undertaken by anybody else; it is too important to be left in other hands; and I contend, that the alteration of the course of the Thames, on which the wealth of the empire is embarked, is a "national question," involving a great responsibility, and can only be therefore undertaken by the Government under the sanction of Parliament. The "Lord High Admiral" is the real conservator of all the rivers in Great Britain, although his power has been from time to time intrusted to the Lord Mayor of the City of London, to watch over and preserve the "fisheries in the Thames." The Lord Mayor, therefore, as the temporary conservator, has not the power to change the course of the Thames. The jurisdiction of the "Lord High Admiral extends as far as the tide flows, in all rivers." Plans of improvement, however obvious, which involve many contending interests, can only be enforced by legislative enactment. The power of the Lord Mayor, to carry out improvements in the Thames, has been set aside by injunctions from the Lord Chancellor.

75. (Mr. *Hume.*) Do you mean that the interests of individuals locally situated may often be at variance with that which you consider ought to be the national interest?—Yes. When the question involves a variety of interests, it is seldom we can persuade people to undertake any work. Our line has been opposed in several instances where the City has attempted to carry it out, not having the power, injunctions from the Lord Chancellor have been moved for and obtained. There is one down at the Isle of Dogs that has been stopped. It adopted our line, and gave permission to do it, but an injunction has been obtained by the Woods and Forests, and the Watermen's Company have obtained another against a proposed pier at Blackfriars Bridge.

76. (Mr. *Hume.*) Upon what grounds do the Woods and Forests interfere with the City, and prevent their carrying out the line which you in your plan have recommended?—I believe it is on the ground that it is the right of the Crown, and not the Conservators of the River Thames.

77. At low water what depth can vessels come up from Gravesend now to London-bridge?—No vessels can pass Barking Reach, that draw more than 10 feet 6 inches water, therefore they are obliged to wait below, and vessels of more than 8 feet cannot pass Limehouse Reach until a certain time of the tide.

78. Has not a great change taken place by the use of steam-boats in the River Thames, which renders the deepening of the river, as they come up at all times, of more importance now than before?—Certainly.

79. What effect has been produced on the river by the number of steamers that now constantly ply?—By the washing of its sides and wear and tear of its banks from steam-boats the wave keeps a greater quantity of silt in a state of oscillation in the river than heretofore.

80. What proportion of the ships navigating the Thames are obliged to lie below Barking Reach at low water?—All vessels drawing more than 10 feet 6 inches.

81. Do not many of the steamers draw more than 10 feet, and are they not equally obliged to study the time of tide for their voyage up?—Yes, always.

82. (*Capt. Washington.*) Is it not the fact that the Royal yacht, with Her Majesty on board, returning from Scotland last year, was detained two hours on her passage to Woolwich, for want of water in Barking Reach?—Yes, I believe that to have been the case.

83. (Mr. *Hume.*) If the recommendation made by you and Mr. Walkar in 1842 had been carried out, Her Majesty might have been landed at Woolwich without detention, and vessels drawing 12 feet water might come up to London-bridge at all times?—Yes, if that improvement had been carried into effect.

84. Besides the delay in waiting for the tide below Barking, in what way are the shallows

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injurious to the navigation?—The vessels are detained so long below Barking Reach waiting for the flood tide that they cannot get up in time to save the tide into the upper docks.

85. If the weather, for instance, is bad, may they not lose the tide, and be delayed in the way up?—I think they are often thus detained.

86. Is not the delay produced consequently injurious generally to all large ships?—Certainly.

87. The delay in your opinion now could be prevented by the application of the means you have pointed out?—Yes.

88. And at the limited expense also, as you believe, of 60,000*l.*?—Yes.

89. It appears in the Report of Mr. Walker, to which allusion has been made, that in 1842 there were 14 different shoals below London-bridge, between that and Barking, impeding navigation?—Those mentioned were all surveyed by me. Coming up the river, the first shoal we meet with is in Erith Reach, called Rand's Hill, a patch in the middle of the river, about 300 yards long by 100 yards wide, which has upon it a depth of 8 feet; with very low ebb tide only 5 feet.

90. Are you aware whether any portion of that has been removed?—Not that I know of. A little higher is Cold Harbour, a point of sand extending from the north shore to near the middle of the river, also with only 8 feet water. A shoal of sand in the same reach (Erith), 200 yards above the last, and having a depth of 6 feet. Dagenham Shelf extends from the north shore, nearly half way across the river, with 8 feet. Barking Shoal, one mile below Barking Creek, nearly in the middle of the river, has also 8 feet. Barking Shelf commences opposite the creek, continuing nearly half a mile down, and extends across nearly two-thirds of the river, with from 6 to 10 feet only, in the line of the navigation.

91. What width in that place have you 10 feet water at low water?—Nearly 800 feet, out of an entire breadth of 1800 feet.

92. The banks on each side north and south shallowing on the shelf to 6 or 7 feet?—Yes.

93. What length is that shelf?—1800 feet, and the spit of it extends from the north side about 1200 feet across the river.

94. What does that shelf consist of?—Peat, covered with gravel and sand.

95. Supposing the bank removed, and 12 feet water across, what would then be the bottom?—If we may judge from the shoal itself, it is still a continuation of the peat.

96. And consequently might be removed by a machine without difficulty?—Yes, but with improved means.

97. Is it below this shelf that the great detention takes place?—I should think it is of daily occurrence.

98. Going up and down?—Yes, both ways.

99. Are there any shoals higher up?—There is a shoal opposite Gallions' Point which extends from the north side about one-third across the river, with 7 feet upon it.

100. What is the nature of that?—A great portion of gravel mixed with sand.

101. How has that shoal been formed?—It is formed by the eddy under the point.

102. Would cutting off that point, as has been already mentioned, prevent any further formation if that bank were removed?—It would prevent accumulation, but I think it is like all shoals in the river, so consolidated that it would require to be removed in the first instance.

103. If once removed, you think the channel would be kept deep?—Yes; Ham Shelf, opposite Woolwich Dockyard, extends from the north shore upwards of half way across the river, for a length of a quarter of a mile, exclusive of patches and projections higher up, and has upon a great part of it only six feet.

104. What does that consist of?—A great portion of peat which they will not remove, but a great portion also is gravel. It is a mixture of peat and gravel.

105. If Hookness, which lies a little above it, were removed, would you then obtain a clear channel way and no bank?—In answer to that question I repeat that Ham Shelf is so consolidated, that it would require to be removed in the first instance. I refer the Committee to my note on Woolwich Reach, additional to my Report of 1842.—(*See* p. 7 *a.*)

106. If Hookness were removed, and the bank taken away, the channel would keep clear of itself?—Yes; Bugsby's Hole is altogether a shoal water reach, in places only eight to nine feet; with some shelves and small shoals having only six or seven feet. Immediately opposite the river Lea, a shoal extends from the north side to the middle of the river, with only nine feet. A little above the entrance of the Lea is a dangerous small rock of concreted gravel in the middle of the river, with only nine feet. That is a curious rock; it is deep water all round it, and it rises like a pinnacle.

107. Has no attempt been made to remove that?—No; although one or two Indiamen have got upon it.

108. As there is deep water all round, what would be the expense of removing that rock?—I cannot say; but I apprehend by the use of gunpowder, it might be blown up for a very small sum. There are two "middle grounds" between Blackwall and Greenwich, which have upon them nine to ten feet.

109. What do they consist of?—A mixture of shingle and mud.

110. (*Chairman.*) Are those easily removable?—Yes; more easily perhaps, than any other shoal in the river. Whiting Shoal, a little above the Commercial Dock entrance, a dangerous shoal in nearly the middle of the river, has in places only seven feet.

111. What is the nature of that?—A portion of it is rock and concrete; it is now being removed. That is the first, as far as I am aware, that they have undertaken to remove. It was stated in evidence before the Committee of the House of Commons, that they had no funds applicable to the purpose. Both the Trinity Board and the City assigned that as a reason for not removing shoals in the Thames.

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112. (Mr. *Hume*). Upon the whole then you see no difficulty in removing all these shoals, and improving the river, except the expense requisite?—None other.

113. What time do you consider it would take to do the whole?—I think it is the work of years. It must be gradually done, and care must be taken also that they do not make it too deep, that is, to run the shoals into holes; there must be constant supervision over it.

114. So as to produce a uniform depth?—Yes.

115. (*Capt. Washington.*) Is the width of 300 feet between the tiers of shipping in the river, as recommended in the Report of 1836, now maintained?—Yes; but it requires the constant attention of the harbour-master to keep it free.

116. Do you think it would be desirable to have, in addition to the conservancy of the City, a Queen's harbour-master to control generally the river Thames?—There can be no doubt of it, and it has been provided for by Act of Parliament.

117. Might not such an office exist consistently with the conservancy of the Thames by the City of London?—Certainly, upheld by the authority of the Government.

118. (Mr. *Hume.*) Are there any other rivers that you have surveyed, upon which you could give any information?—I have surveyed the river Medway.

119. (*Chairman.*) Are there many shoals in the Medway?—Yes; nearly every reach has its shoals.

120. (Mr. *Hume.*) What is the depth of water in the Medway, up to Rochester Bridge?—I think we could carry at low water, through Long Reach, which is the shallowest reach, 10 or 12 feet.

121. How high does the water rise at Rochester Bridge?—Between 18 and 19 feet.

122. Are there any shoals between Rochester Bridge and Sheerness?—I may venture to say that every reach has its shoals.

123. In what way are these shoals produced?—By the irregularities of the river.

124. (*Capt. Washington.*) And susceptible of improvement, in the same manner as those in the Thames?—Yes.

125. Is the Medway under the conservancy of the City of London, as well as the Thames?—As far up as the city boundary stone. The rest falls under the Rochester Bridge Commissioners.

126. (Mr. *Hume.*) Have any operations taken place to deepen that river, or remove the sand?—The Government have attempted it, and indeed are still improving the harbour or reach opposite the Dock-yard at Chatham.

127. In what way?—In taking up the mud and depositing above high-water mark.

128. Would it not be a better plan to ascertain the cause of that deposition, remove the projecting points, and fill up.—Yes; it is the same process. The Medway is more irregular than the Thames, and would require greater works, but still it would be improved by systematic dredging.

129. Is there any impediment to vessels coming up from Sheerness to Chatham?—Yes; they cannot get up Long Reach, except at a certain time of the tide.

130. What is the rate of the current at spring tides?—The rate of the Medway never exceeds two miles, and at neap tide, a mile, or scarcely a mile and a quarter; whereas the Thames is three miles.

131. How high does the tide flow above Rochester Bridge?—Up to the Castle Shoal and Maidstone Locks.

132. (*Capt. Washington.*) If those locks did not exist, would not the tide flow at least four miles higher up the Medway?—I believe so.

133. Is not Rochester Bridge a great obstruction to the free flow of the tide?—Certainly.

134. Then the shoaling up of a public river, chiefly used for Government purposes, is mainly attributable to the obstructions to the tidal scour caused by Rochester Bridge, and the above-named locks?—There can be no doubt of it.

135. Are you aware that Admiral Sir Byam Martin, and other Commissioners of the Navy, reported in strong terms against the obstructions that the said bridge and locks caused to the ebb and flow of the tide in the river Medway, as far back as the year 1818?—I have understood so.

136. (Mr. *Hume.*) Has there been much land enclosed on each side, so as to interfere with the tidal water there?—The Medway, like the Thames, has been embanked in former times; but in the Medway particularly, there is left in the centre a great deal of land, which is continually breaking down, falling into the river, and increasing the mud banks.

137. (*Chairman.*) Which part of the Medway are you alluding to?—The upper part in particular.

138. Is there not another channel between Gillingham and Chatham?—That is a small channel navigable by steam-vessels at high water only.

139. (Mr. *Hume.*) From the knowledge you have acquired from surveying, is it your opinion that the same principles on which you have recommended the improvements in the Thames, could be applied equally to improve the Medway.—Certainly.

[*The Witness withdrew.*]

Adjourned.

Note on Woolwich Reach.

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The definite lines of embankment drawn out upon the plans which are to accompany this Report, although laid down with the greatest care, and with reference to the foregoing explanation of cause and effect, in tidal rivers may yet be found subject to the modification, which experience may from time to time suggest to the civil engineer. Thus from Chelsea to Blackwall, the embankment is of a character to convince the most sceptical of its importance and utility. But the vast change in the direction of the river, which the lines of the proposed new embankment in Woolwich Reach would produce, involves so heavy a responsibility, and leads to so great an outlay, that the subject requires deliberate discussion before it could be recommended to the consideration of the Government, by whom alone it could be undertaken. The nature of the service on which I have been for a long time engaged, has given me opportunities of observing the effects of projected improvements, in all parts of the river, but nothing that has hitherto been devised (and the Lords of the Admiralty have invariably bestowed the greatest care and attention on the subject,) either in the taking away of Cooper's Ledge or the removal of "a solid projection" above the dockyard, have, in the least, increased the current, deepened the harbour, or prevented the deposit of mud on the side of the dockyard; indeed, I am now fully convinced that nothing effectual can be accomplished without leading the ebb-tide to impinge upon the dockyard wall, instead of being, as it now is, deflected from it. The port of Woolwich had formerly depth of water sufficient to float line-of-battle ships. In 1800, the Benbow (74) lay at Woolwich with all her stores, and frigates were frequently entirely fitted there, whereas now the hulks take the ground at low-water ordinary spring-tides; thus the decrease in the depth of this Royal Harbour may be estimated at 7 feet in 45 years, and its breadth proportionally diminished. The serious nature of this change requires little comment; it is certain it will always be expensive to keep the harbour of Woolwich free from the accumulation of mud, placed as it is in a position exposed to the disadvantage of lying in a recess. From this brief summary of the cause of the gradual deterioration of the port of Woolwich, in which the port of London doubtless participates, it may be inferred that the most direct means of preventing it in future would be to adopt the improvements suggested by the able Hydrographer of the Admiralty, which, although involving a great expenditure, would, in the end, be found the most economical; but when the incalculable benefits arising from a judicious outlay of capital are taken into consideration, it cannot be deemed superfluous or inexpedient to take measures to prevent the deterioration of the port of Woolwich, which is become so much more important since the introduction of steam into our navy, and the vast improvement in the dockyard by an extensive steam factory. It is impossible to reflect without regret on what the Thames actually is, and what it might have been had the care and wealth employed in disfiguring its banks for private ends been laid out in embellishing and improving them upon the basis of the public weal.

FREDERICK BULLOCK, *Capt. R.N.*

Friday, 30*th January*, 1846.

Present:—

Rear-Admiral BOWLES, C.B., in the Chair,

Mr. HUME, M.P. Mr. GOODSON, M.P. Captain BEAUFORT, R.N.	Captain WASHINGTON, R.N. Mr. BARING, M.P.

(The Admiralty Chart of the River Thames, on the scale of 20 *inches to a statute mile, made by Captain Bullock, R.N., between the years* 1831—4, *was laid on the table.)*

Mr. *James Walker*, C.E.: Mr. *Edward Leigh Pemberton*, Solicitor to the Woods and Forests; and Mr. *Charles Pearson*, City Solicitor, examined.

Mr. *Walker*.

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140. Mr. *Hume* (to Mr. *Walker*.) Will you inform the Commission what led to your making a general survey of the River Thames, and your report on the manner of improving it, which was printed in 1842?—About two years previous to the date of the report, the state of the Thames' banks above London Bridge, at low water, arising from the removal of the old London Bridge allowing the tide to ebb lower and to expose the mud, together with the shoals in the river, which were also injurious to the navigation, and also to the supposed effects of the encroachment upon the river by the new Houses of Parliament, led to a communication between the Treasury, the Crown Lands and the Lord Mayor, as Conservator of the River, as to the expediency of having a survey made. I was appointed by the Crown and the City for the purpose; the subject was referred to a Committee of the House of Commons, who went into evidence and estimates of great length, but made no report of their opinion: this was, I think, entirely, or almost entirely, confined to the surveys above London Bridge. Some time after this, much I believe through the advice of the City Solicitor, the City ordered a more general inquiry, extending down the river to their limits. I was again applied to, partly I believe through the recommendation of the Admiralty, and Captain Bullock, R. N. entirely through the recommendation of the Admiralty, was joined with me. The report, to which you refer, was the result of that survey.

141. Have any measures under your direction been taken by the City to carry out that report of yours?—There has been nothing done under my direction. I understand that the City, at present, are employed in removing one of the worst shoals in the upper part of the river, called Whiting Shoal.

142. Adverting to that report which you made in 1842, supposing there were the means, which you have stated in your former evidence are requisite, in what way can the improvements of the Port be carried on most beneficially, according to your views?—Below London Bridge, and below the wharfs upon the river, the case is very simple. It consists in the removal of

Mr. *Walker.*

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shoals, which the action of the tide has not been able to remove; those are peat, silt, &c., which being once removed are not likely to return, and which the Trinity House would have removed long since had the material been fit for ballast. They might be removed, by contracting with the owners of steam-dredges, under a regular specification. The material could be removed behind the banks of the river, and placed upon the low ground of the marshes, so as to raise the ground. As I have already stated, one of the worst of the shoals, Whiting Shoal, is now, I understand, being removed by the City from, I presume, their own funds; but when the inconvenience to the navigation by these shoals is considered, I think that they should all be removed with as little delay as possible. The embankments and cutting off the elbows of the river, which are shown upon the plans, would be very useful, and might be made afterwards: the cost of doing them was not included in my estimate of 60,000*l.* Above London Bridge the circumstances are very different; here the sides of the river were supposed to be advanced in places where the river is now too wide, and the ground for filling behind the embankments was to be taken from the shoals; this being a specific condition, when grants for embanking should be made. Considering the vast number of varied interests, and the difficulty of forcing a general scheme in such cases, I have always thought that the improvement would be best effected by degrees, as parties applied for leave to extend their premises, just as the present wharfs were originally formed. The fear of partial embankments causing a deposit of mud ought to be much lessened now by the observation that, excepting in particular places, where the river is very much too wide, as between Waterloo and Westminister Bridges on the City side, the mud has been chiefly washed away by the steam-packets, so that the nuisance arising from the mud upon the banks of the river is now very small, compared with what it was some years since. No injurious deposit to parties on either side of the new embankment for the Houses of Parliament has been consequent upon that projection.

143. With respect to those improvements which you think might be made by degrees, do you apply the same rule above London Bridge as below London Bridge? You state that the making of the embankments might be best effected by individuals in different parts, does that allude to embankments above or below London Bridge, or to both?—Chiefly above London Bridge, but partly below.

144. You state that the expense of cutting off the angles and filling up the creeks below London Bridge did not form any part of your estimate; can you give any estimate of what that expense would be?—I cannot off hand, I could by calculation.

145. Have you any reason to know whether the parties whose property would be affected below London Bridge might be induced, at their own expense, to carry out the improvements which are suggested by your survey?—As far as the buildings go, perhaps I may almost say as far as Blackwall on the Middlesex side, I think they would, but below that I do not expect that they would. I rather think, but I speak under the correction of the City Solicitor, that all the part round the Isle of Dogs is being embanked by the lessee, under a grant from the City; but I was not consulted about it, and therefore I only speak from report.

146. Would you be able, if required, to form any estimate of what the total amount necessary, in order to carry out your own report, over and above 63,000*l*, would be below London Bridge?—I could do it if time were allowed me; but I do not think that that is so important for the immediate relief of the navigation of the river.

147. You are of opinion that that ought not to stop the general deepening to which your report alludes?—Certainly not the removal of the shoals from Gravesend upwards to Limehouse; it is not so much a general deepening, as I have stated in my report, but a removal of the shoals which stand above the general level.

148. Would you begin your improvements at Gravesend, or at London Bridge; or in what manner would you recommend the improvements to commence?—Referring to the parts below London Bridge, I would remove those shoals first which are most in the way of the shipping, such as Barking Shelf, which is one of the worst. Referring to the portion above bridge, the priority of beginning would depend upon the priority of application to embank. The Crown have an opportunity of setting a good example upon their own estates.

149. In allusion to the answer which you gave on the 11th of July last, respecting the divided authority at present claimed over the bed of the river, do you consider that an Act of Parliament would be requisite, or in what way do you consider that the difficulty which now interposes would be best removed?—I am not aware of an Act of Parliament being required, unless it be to raise a fund for the improvements below bridge, and to settle the rights of parties, so that they may draw together in order to effect the improvement. At present the whole process, as far as regards embanking, is at a stand in consequence of the Chancery suit between the Crown and the Lord Mayor, as Conservator, respecting the right of property in the soil of the river, so that the smallest grant by the City is liable to be objected to by the Crown, and therefore individuals are averse to subjecting themselves to being prosecuted by the Crown. Of the merits of the particular grants which the City have made I know nothing, as I have not been consulted by either party respecting them.

150. Are the Commissioners to understand that, in the present state of disputed authority, the improvements which might otherwise be made are at a stand?—Yes, entirely. I refer to the improvements above London Bridge. I am not aware that the Crown has at all interfered to prevent the removal of shoals below London Bridge to the depth of the river; but where anything has been attempted by parties going beyond high-water mark, by wharfs or otherwise, I believe they have been prevented.

151. (Captain *Washington.*) Then all parties would agree that the shoals, and especially the Barking Shoal, that prevents access at low water to the Royal Dock-yard at Woolwich, should be at once removed?—I think so.

152. (Mr. *Hume.*) To what authority do you conceive that the carrying out of the improve-

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ments recommended in your plan should be intrusted?—If the improvements are to be effected out of the funds of the Corporation of London, it seems reasonable that that Corporation should have the direction of them. If a separate fund should be reised by a small tax upon shipping and trade, or otherwise, which I have just referred to in my report, then the different interests might expect to be represented; for which purpose a commission would be less objectionable and more efficient, as preventing counteracting tendencies. The City officers are permanent, and must be well acquainted with the laws which affect the various questions; but the Chairman and some of the members of the Navigation Committee change annually; which constitution is unfavourable, both by preventing a thorough knowledge of the subject, which cannot be expected to be acquired in one year, nor can the same interest or responsibility be felt by individuals, however qualified, who are to remain so short a time in office. This objection could, of course, be removed by having a standing committee. The question of a Thames Commission for immediate proceeding, until something permanent could be arranged, was much discussed just before Lord Melbourne's Administration went out of office, particularly by the then Secretary to the Admiralty, Mr. Wood, who had a list of names for Commissioners. I think that he was in communication with some of the City officers, and I understood, at the time, that the list was nearly agreed upon, but the matter appears to have dropped soon after. The question of the right of soil has since been raised, and the principal scene for action has been the Court of Chancery. I need not say that I consider this a most injurious state of things to exist between two parties, both of whom profess one object, namely, the public good.

153. Then it is your opinion that an Act of Parliament may be passed, or powers granted to Commissioners, and that the parties entrusted with the execution of the work should be understood to continue from the commencement to the end of the proceeding—that the Board should be permanent?—Yes; at least a portion of the members.

154. You have not stated whether you would begin any operations in the lower part of the river first or last. You speak of shoals; would you begin at Gravesend or at the upper part of the river?—I do not think there is occasion to begin at Gravesend. It is a good way above Gravesend where any shoals occur; but I would begin at those shoals first which are an impediment to the shipping. I should say generally that I do not think the removal of the shoals below bridge would have anything like a practical effect upon anything above London Bridge.

155. Supposing there were funds for the purpose, in what time could the improvements, suggested in your report, below bridge, be completed?—I think in three years. I need not inform this Commission that labour is considerably higher than it was at the time when I made this report, therefore you must make a liberal allowance for that in estimating.

YARMOUTH.

Yarmouth.

156. (*Chairman*) When were you consulting engineer at Yarmouth; what was the last time you were down there?—For the harbour, about the year 1837.

157. Did you then give any plan for building a bridge between the South Town and the town of Yarmouth?—I did.

158. Was that plan acted upon?—It was not entirely.

159. Can you state the reason why it was not acted upon?—At the time the plan was made there was a plan for a temporary bridge and a permanent bridge. That part with regard to the temporary bridge was acted upon, and the bridge was built; and the plan for the permanent bridge was laid aside till the revenues of the corporation should enable them to build it. The time came when they were enabled to build it, and then, I believe, they thought it more advisable to advertise for plans. I was not at all disposed to be a candidate for anything of the kind, and therefore I gave in no plan; the Commissioners had formerly been in possession of my original design. As I thought this not very handsome treatment, I requested them to return the plan; and I stated, in reply to their offer, that I would give them the 100*l*. which they had paid me for the plan. They sent it back accordingly. Three designs were given in, and the Commissioners referred the three designs to me to say which was the best. I need not say that in giving that opinion I entirely excluded my own plan, as I felt it would be only proper to do that, and I reported in favour of the plan which I thought the best of the three; of course it was a matter of relative merit. I think after that the Commissioners advertised for contractors for this plan. The tenders were sent in, one of which they accepted, and the bridge was begun; but owing to, I believe, the inefficiency of the contractor, or some other cause which I do not know, the thing has been at a stand for a considerable time.

160. (*Captain Beaufort.*) Was there an opening in the bridge which you proposed?—Yes.

161. Of what length?—I speak from recollection now, perhaps 40 feet.

162. Upright, or with a spring arch?—Upright.

163. In making any other bridge between Yarmouth and Norwich, or between Lowestoft and Norwich, what opening do you think should be insisted upon; or, in other words, what sort of trade would be carried on up to Norwich?—I always think, in these cases, one ought to look a good way forward. I should say the minimum, without knowing the point to which the gallant Commissioner refers, ought to be 30 feet; that would be enough for a vessel of 200 tons to warp through.

164. With that condition, you do not see any objection to allowing railways to cross that river in more than one or two places between Norwich and Yarmouth?—Generally I do not; but I think it is a safer thing for the Admiralty to refer the question to me, and if they do I will give them a written answer.

165. (Mr. *Hume.*) Are you aware of the rapidity of the current at the place where the

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bridge now is, from the narrowness of the passage?—Yes, I am. Every person who has visited Yarmouth knows that it is very rapid. I was at one time very well acquainted with it, but it is now some years ago.

166. Did you not state, reciting Mr. Rennie's opinion at the time, that it was your opinion that whenever a bridge should be built, there should be a greatly increased water-way given to what then existed?—I think I did; and I am almost sure that my plan for the bridge gave an increased water-way. I do not know what water-way the bridge, which the Commissioners have begun building, gives. The evil, as it affects the question in which the Admiralty are interested, is this, that a narrow bridge forms a dam, and keeps the water up in a large reservoir, which forms, as it were, the lungs of Yarmouth Harbour (the Braden,) so that it never gets down to the level of low-water at sea by a good many feet, just as the old piers at London Bridge kept up the water five feet higher above bridge than below. I ought to observe that at present the embankments over the whole of that country are conformable to the present high-water. If those impediments were removed to the full extent, and the water allowed to rise fully over the country, it would require attention to be paid to all the embankments of the country. It is therefore a large question, which requires consideration.

167. Are you, however, aware that the greatest injury that is done to the land above bridge is done by the inland waters?—Yes.

168. Does not the narrow space prevent the water from going off, and consequently keep the inland waters higher than they otherwise would be if the bridge was wider?—There is no question about it.

169. So that while it prevents the inflowing of the tide, it prevents the outflowing of the land floods?—Yes; the whole of the property up to Beccles on the one side, and up to Norwich on the other, is very much in want of good drainage.

170. Since what year have you been consulted as to the execution of works at the Brush, or at the pier-head at Yarmouth?—I have not been consulted since 1837.

171. Have you lately been appointed engineer?—Yes, within the last week or 10 days, I had a letter informing me of the appointment.

172. (*Captain Beaufort.*) Who is engineer now? A sensible, clever naval officer, Capt. Spencer Smyth, who is the resident superintendent and harbour-master, has superseded me there. I have never seen anything that he has done; but, as far as report goes, he is a very efficient officer of the Commissioners.

173. (Mr. *Hume.*) Have you been, since you received your appointment, consulted as to the expenditure of 19,000*l.*, recommended by Capt. Smyth, to improve the harbour?—No; I never heard of a proposal of the kind till this instant. The Commissioners of Yarmouth consist of a number of gentlemen from the county, and, I think, either four or six members of the boroughs of Norwich and Yarmouth. Upon my recent appointment there was a division at the meeting; there were six for me and five against me. It does happen unfortunately that the county Commissioners and the borough Commissioners do not generally agree well together. I think, however, that it is fair to say, that since I first knew Yarmouth, the harbour, under the superintendence of the Commissioners, has been very much improved, and the bar now is very steady; they have generally seven feet upon it at low water, and some 30 or 40 years back there was not half that.

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174. (To Mr. *Pemberton.*) What is the present state of the suit between the City of London and the Woods and Forests respecting the Thames?—The present state of the suit between the Crown and the Corporation of London is a state of abeyance, pending an appeal to the House of Lords.

175. When was that suit begun?—The suit was commenced in February, 1844.

176. When will it probably be ended?—I cannot even guess at the time of its termination; I do not expect its termination in less than three years. By way of explanation of these answers, I will state the nature of the suit, and the proceedings which have taken place in it. The suit was instituted by an information filed by the Attorney General in the Court of Chancery; to which Court (as the Counsel for the Crown consider) the equity jurisdiction of the Court of Exchequer in Crown cases has been transferred. The information seeks a discovery of the charters or other grounds on which the Corporation of London claims title to the ownership of the bed and shores of the river Thames, and it prays that the rights of the Crown and of the Corporation respectively may be ascertained and declared by the decree of the Court; and that if it should be necessary for issues at law to be tried, the same may be tried under the direction of the Court, and that the right to the freehold in the soil of the river and the shores thereof may be established in the Crown, to the end that multiplicity of suits may be avoided, and the claims of the Corporation, and of the numerous parties claiming under grants from them, may be examined and determined. We were led to believe that the Corporation of London intended to put in a full answer to the information, and an unusual length of time was allowed them for the purpose, but eventually they were advised to demur. The demurrer was filed in July, 1844, the defendants insisting that the Crown was not entitled to a discovery of their title; that the subject-matter of the suit was a matter for trial in a court of law, and that the Court of Chancery had no jurisdiction to entertain it. The demurrer came on for argument in January, 1845, and judgment was given in April; when the Master of the Rolls overruled the demurrer, and decided that the Court of Chancery had jurisdiction, and that the defendants were bound to answer. Against this judgment, the Corporation of London have appealed to the House of Lords, and further proceedings in the Chancery suit are stayed till the appeal has been heard and determined. I cannot tell when the appeal is likely to be heard; but even if it should be heard during the present session, we shall be still far off the final determination of the real question in dispute, namely, in whom the ownership of the bed and shores of the river Thames is vested, whether in the Crown, or in the Corporation of London,

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Assuming that the House of Lords affirm the judgment of the Master of the Rolls, the Corporation will have to answer the information, for which they will no doubt crave ample time. When the answer comes in, the Attorney-General may find it necessary to take exceptions, or to amend the information, and require a further answer, or it may be necessary to take evidence; in short, many causes may retard the progress of the suit, and when it is once set down for hearing, it must wait its turn, unless the Master of the Rolls will advance it before others; and then in all probability, when the cause is heard, the court will direct issues at law, and after they have been tried. it is to be expected that applications will be made for new trials, before a final decree is pronounced. From this narrative, I think it will be apparent that the ultimate establishment of the right of ownership is not to be looked for in a shorter space of time than three years.

Mr. *Pearson.*—I think that is a very fair statement; and I am quite as unable as Mr. Pemberton to say when the suit will be concluded.

177. Is it possible to prolong it five years?—Mr. *Pemberton.*—Yes, very possible; when I say possible to prolong it, I think it may very likely be prolonged five years.

178. Have any steps been taken by the Woods and Forests to prevent alleged improvements being made by the City of London?—Not what the Board of Woods consider to be improvements. The City of London have granted licences for embankments both above and below bridge. There are three licensed embankments, I think, against which this very suit prays an injunction. The parties to whom those licences have been granted are defendants to the suit as well as the Corporation of London, and the information prays an injunction against them, that they may be restrained from proceeding under the licences which the City have granted.

179. Has an injunction been granted?—An injunction has not been granted, but the Corporation of London have undertaken not to grant any further licences, or to do any work touching the soil of the river, without a week's previous notice to the Commissioners of Woods and Forests.

180. Are the Commissioners to understand, that all these improvements are virtually stopped by the present state of the suit?—I think the Commissioners must not assume that they are improvements. The Board of Woods complain of them as nuisances.

181. But the alterations are stopped?—Yes.

Mr. *Pearson.*

182. (To Mr. *Pearson.*) You have heard the answers which Mr. Pemberton has given; how far do you concur with him?—I concur in everything that has been said by Mr. Pemberton; but I would make a little addition to it. This information was filed, I believe, for the purpose stated by Mr. Pemberton; that is, to prevent the completion of certain embankments being made under licences from the Corporation. The information stated that those embankments would be a nuisance and an obstruction, and that the Corporation claimed the right of committing nuisances in the river, by granting licences to embank in a manner which would be an obstruction to the navigation.

183. Between high-water and low-water mark?—Exactly. The Corporation demurred to so much of the information, as called upon them to show their title to what they called their estate, and to so much of the information as sought to obtain, through the instrumentality of the Court of Chancery, what they say the Crown could only get power to obtain through a court of law instead of a court of equity, throwing ourselves on the statute of James the First, which regulated the proceedings of the Crown where it came in controversy with the subject; as to so much of the information as stated that the Corporation claimed a right to grant to any man licences to commit a nuisance, or to obstruct the navigation of the river, and as to so much of the information as alleged that, in point of fact, those several licences which had been granted, would have that tendency and effect, the Corporation did not demur to that, but put in an answer, taking issue, denying the fact, and stating that the Corporation never claimed a right to commit a nuisance; that they had granted those licences in pursuance of a plan which was suggested to them by eminent engineers, which they believed would, if carried into execution, be for the general benefit of the river; and that issue has never been disturbed by the Crown. It therefore stands with an averment on the one side that this is n nuisance, and a denial of it on the other. But inasmuch as much larger matters are involved in the information, it has probably not been thought worth while, by either party, to agitate the discussion by going to a trial at law upon this question, when we admit that it is not our intention to proceed with the granting of licences while the subject is undetermined. Those circumstances and those arguments are stated very shortly and neatly in the case which is now before the House of Lords; therefore, with your permission, I will draw a line down so many lines of the margin as refer to that, and put it in. (*See* p. 15).

184. Is it to be understood that the licences were granted by the City, with a view of carrying out, at those particular parts, the plan of Mr. Walker?—Yes.

185. Strictly with that view?—Strictly with that view and no other.

186. Since Mr. Walker's report was made, have any portions of the river been embanked, according to the recommendation of Mr. Walker's report?—There have; one of those portions is one of the cases which I have referred to as being the subject of the information, and another was in progress; one is completed, the two others were in progress; one of them was a very extensive embankment at the Isle of Dogs.

187. Has Mr. Walker, on whose report you intended to act, been appointed, or seen the alterations which have been made?—Mr. Walker having laid down the line, the Navigation Committee thought that in granting licences in strict conformity with that line, they were acting upon Mr. Walker's advice; and I do not think that they have called on Mr. Walker specifically to see whether the circumstances of the particular locality were such as to require a strict adherence to that line, or its relaxation. Whether the committee have acted quite rightly in that or

not, different persons may form different opinions; but I believe they thought they were justified in all cases in granting the licence, provided it was coincident with the line laid down.

188. The Lord Mayor claims, as Lord Mayor, to be Conservator of the Thames from Staines to Yantlet Creek?—Yes.

189. Through what medium, or in what way, does he exercise that authority?—By himself and by the Water Bailiff, who is by custom, sub-conservator of the river The Court of Common Council, since the year 1787, have been in the habit of appointing annually a committee, consisting of one member from each ward, with a certain proportion of Aldermen, who are the eyes and the ears of the Lord Mayor as regards the navigation, who execute the duties and the powers which are supposed to be vested in the Lord Mayor as Conservator, and in the Corporation as owners of the soil and bed of the river.

190. Are the members of that committee changed annually?—One portion of them goes out annually, I think a fourth; the whole, in four years.

191. Do not they make visits, once or more in the year, to the limits, with a view of seeing whether any and what encroachments have been made in the navigation?—I do not think that they go to the whole extent of the jurisdiction on the Yantlet side, but I think they go to the whole extent on the Staines side.

192. Does not the Lord Mayor make a triennial visit?—That is not a visit by the Navigation Committee, but by the Lord Mayor as Conservator; besides that, the Navigation Committee, I think, go annually as far as Staines; but they make many visits during the year, I should think twenty or thirty, over a great portion of the jurisdiction.

193. Was Captain Bullock employed by the City to survey the river?—Captain Bullock was employed in company with Mr. Walker and the other gentlemen.

194. Have you seen the survey of the river by Captain Bullock?—I have.

195. Was that made at the expense of the city?—No.

196. At the expense of the Admiralty?—I presume so.

197 Has that survey ever been laid before the Lord Mayor and the Navigation Committee?—Never, that I am aware of.

198. Have the Corporation been aware of the number of shoals existing, as shown by that survey, between London Bridge and Gravesend?—I am not aware that they have been acquainted with the existence of any shoals, except those mentioned in the report of Mr Walker, to which Captain Bullock was a party.

199. Have you seen the reports of several officers appended to Mr. Walker's report?—I have.

200. Have any complaints been made by merchants or dock proprietors, or any individuals, of the continuance of those shoals?—I am not aware of any specific complaints having been made of any particular shoal; I am aware that there have been persons connected with the docks who have complained generally of the existence of some shoals, but I do not think it specifically referred to any in particular.

201. Had any measures been taken to remove any of those shoals before that on which they are now employed,—the Whiting Shoal?—Not since the report of Mr. Walker of 1842.

202. Is that shoal entirely removed now?—I think not entirely, very nearly. I saw a map of it the other day, with the coloured parts which had been removed, and it appeared to me that four-fifths of it had been removed.

203. Have any other measures been taken to remove the shoals mentioned in Mr. Walker's report, than that upon which you are now engaged?—That was commenced before the suit was instituted: contemporaneously with that was the granting of licences, in conformity with Mr. Walker's recommendation, and also the consideration of several others, altogether including some miles of embankment; but when the suit was instituted by the Crown, I advised the Corporation to hold their hand, and to take no further proceedings in this respect, except to complete that which they had commenced, the removal of Whiting Shoal.

204. Are you able to state whether it is the intention of the Lord Mayor and Corporation to carry on further works with a view of deepening the river, as recommended by Mr. Walker?—I should think that while the question between the Crown and the Corporation remains in an unsettled state, they will not. The alterations which have been made by the Corporation have cost them during the last two years 3,600*l.*; they received before the institution of the suit 900*l.*, as fines for intended embankments. By a resolution of the Common Council immediately after the date of that report, every shilling that was to be received by the Corporation for licences to be granted was to constitute a separate fund, to be strictly applied in carrying into execution those parts of Mr. Walker's plan which entailed expense upon the Corporation. They have therefore received 900*l.*, and have expended 3,600*l.*, looking to future receipts to recompense them their advances. If their title is put in peril, they probably will not think it right to go on making advances to the amount of 60,000*l.*, as proposed by Mr. Walker, if there is no reasonable probability of their having any means of recovering that advance.

205. If the Woods and Forests do not interfere to stop their proceedings, is the City prepared to carry out the deepening of the river, as recommended by Mr. Walker?—I have no authority to speak in the name of the City, but I think I may say that the recommendation which the Corporation had received would have led to that result. Whether the whole 60,000*l.* would have been undertaken at once, or not, it is impossible for me to say. I can hardly say that I think it would have been; but if the Crown had not interfered to disturb the City's title to the soil, I think it might have been accomplished in the course of years.

206. What funds are there which can be made applicable to the carrying out of Mr. Walker's plan for deepening the river?—It rests with the corporation to say what funds they may be willing to apply to that purpose.

207. Is there not a rental fund arising from the sides of the river?—Yes, for leave to use the soil and shores of the river.

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208. Can you state what is the amount of that?—It varies, I think, from 1,500*l.* to 2,000*l.* a year; but if the Board will allow me, I will send them an exact statement of it.

209. Do you consider that that might be increased, so as to render the proceeds available for the objects of the improvement?—I believe that if the Corporation were willing to apply what they consider to be their revenues from the river to that object, a very considerable sum might be obtained from that source. Thus, for instance, 900*l.* have been received during the last two years from applicants for leave to embank. If the Crown had not interposed, this would have been largely increased.

210. Has there been any discussion in the Corporation upon the propriety of applying special funds to the purpose?—The Corporation adopted a resolution three years ago, that every shilling that should be received for new grants should not fall into their general funds, but should be specifically applied to the object of carrying out Mr. Walker's plan.

211. Has the money been so applied?—Strictly so. An advance of 2,700*l.* was made to it by the Corporation, and I have no doubt at all that they would have advanced any sum to that fund which might have been requisite to carry its purposes into execution.

212. Has there been any question raised in the Common Council as to the propriety of raising a sufficient sum to carry Mr. Walker's plan, as a whole, into effect?—It has been a subject of conversation among the members of the Corporation, but to my knowledge and belief it has never assumed the character of a discussion by the Corporation as a body.

213. Can you furnish a statement of the amount of dues received from ships entering the port of London?—I believe there are no dues receivable, except tonnage dues, which will expire, I believe, this very year, or next year.

214. (*Captain Washington.*) Are there not tolls levied upon coals, corn, fish, and fruit, all water-borne to London?—There are metage dues collected by the Corporation, and belonging to the Corporation, upon various articles, of which coals, corn, and fruit are part.

215. Does not the income arising from that amount to above 50,000*l.* a year?—The income to the Corporation from metage duties amounts, I believe, to 50,000*l.* a year, including the local duties.

216. Entirely levied upon goods water-borne to the port?—Not only water-borne, but land-borne as well. They are metage dues, which belong to the Corporation as their property, just as much as market and other tolls are appurtenant to many gentlemen's estates.

217. (*Captain Beaufort.*) What would be the proportion of water-borne to land-borne?—The proportion is enormous in favour of water-borne: coals are almost all water-borne; but the duties upon coals are all appropriated—they are all mortgaged very deeply.

218. Is not the rental fund one upon which there is a contest at this moment between you and the Crown?—Yes; and as the Crown claims the rental fund, and the Corporation claim the rental fund, I could not advise the Corporation, while that question is in litigation, to borrow a sum for these improvements, it would, in fact, be borrowing it upon their own resources for public purposes.

219. (Mr. *Hume.*) Is there not a fund created, called the Coal Market Fund, which, under the Act of Parliament, was to be a penny a ton?—The fund for the market is now at an end; and the penny is transferred, by an Act of last session, to Her Majesty's Government for public improvements.

220. It was 13,000*l.*, was it not?—Yes. It will be more now.

221. Are you aware whether there is any surplus of that fund over and above the expenses of carrying on the market, which might be applied to the purpose of improving the river?—I think not.

222. Will you ascertain that?—I will.

223. (*Captain Washington.*) Are you aware of any sum of money having been expended by the Corporation of the City of London in deepening the river, except in the removal of the Whiting Shoal?—I am aware that there has, but I cannot state the particulars.

224. (Mr. *Hume.*) Have any conversations or any proceedings taken place to enable you to say what would be the wish of the Lord Mayor or the Corporation with reference to the improvement of the river?—I believe a very great and anxious desire exists among them to contribute to the improvement of the river; I am convinced this feeling existed amongst them before this information was filed. This report is an evidence of it.

225. Are you able to state whether, pending the present suit, the Corporation will be ready to concur in any Commission or Act of Parliament, with a view of carrying out Mr. Walker's plan?—The Corporation have not spoken as a Corporation, or by any of its Committees, I am not, therefore, able to say that they would. But when I first received from you an intimation that it would be desirable to examine me, I stated that my situation as Solicitor of the Corporation should exempt me from inquiry; I afterwards went before the Navigation Committee, and told them that it was desired to examine me, and I stated that my profession would protect me from answering questions, but that if sanctioned by the Committee, I should answer any questions that might be put to me with frankness; if you ask me what I think the Corporation would be prepared for, I think they would be prepared to consent to measures being adopted which would prevent the river getting into a worse state than it now is in, and to carry out Mr. Walker's plan, not by a Commission, but by an Act of Parliament. I have no hesitation in saying that I believe there is the greatest disposition on the part of the Corporation to concur in any reasonable measures which may be devised to carry out the plan, pending the differences between the Crown and the Corporation.

226. (*Captain Beaufort.*) Can you find funds?—I think some plan might be hit upon of doing it.

227. (Mr. *Hume.*) Have you considered whether it would be necessary to have an Act of Parliament, or a Royal Commission, or in what way it would be best to carry out Mr.

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——
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Walker's plan?—My own opinion is, that an Act of Parliament would now be necessary. The title of the Corporation has been impugned by the Crown, and therefore no wise person would take an impeached title from the Corporation under such circumstances. If we granted leave to embank, we should do it with great disadvantage if we were doing it upon a questionable right; if the Crown and the Corporation should come to an arrangement pending the suit, I think an Act might give validity to any arrangements that took place in the mean time.

228. That is as regards the portion which might be obtained from the sides of the river without interfering with the bed of the river?—Yes.

229. (Captain *Washington.*) But besides the embankments that might be made on the river, would there be a disposition to dredge the river?—Certainly; but it cannot be supposed that that which is expensive would be done, and that which is remunerative would be left undone.

230. (Mr. *Hume.*) Looking to the advantage from the sale of property acquired on the banks, how long do you contemplate that the operation would continue?—I do not conceive that the whole of Mr. Walker's plan will ever be carried out, if by that it is meant that the lines which are laid down upon that map are to be strictly followed. But I believe that all the important parts of the plan affecting the present interests of the river, such as the deepening of the river and securing the banks, might be reasonably expected to be carried out without compulsory powers, in the course of five years. I know that others differ from me in the belief that it would be so extensively followed; I believe it would.

231. (*Captain Beaufort*). Of course, Mr. Walker's plan implies wharfs on the side of the river?—Mr. Walker's plan assumes that the owners of wharf property shall be called upon to secure the shores of the river on each side upon the lines laid down on the map; the channel of the river might then be dredged in the manner pointed out in the plan, without endangering the security of the adjoining property. The shores between high-water and low-water mark within the lines on Mr. Walker's plan, if allowed to be secured either by solid embankment or by dwarf piling, would be a valuable easement to the adjoining wharfs; at present the owners pay rents and fines to the Corporation for leave to drive piles and to moor barges or timber floats on the shores; these sums constitute what is called the rental fund, and in my opinion the owners of the wharfs who permanently occupy a portion of a public river would have no right to complain if they were compelled so to secure the shores, as to enable the proper authorities to deepen the channel without drawing down the soil into the river. The whole of these alterations might be executed under the authority of the Corporation, subject to a veto in the Admiralty, if they thought any such alteration injurious to the navigation. The difference in the amount between where they now pay for the enjoyment of this easement as by sufferance, and the sum they would and ought to pay for it as a legalised right, would in many cases be considerable, and I look to this as a legitimate fund to defray the charges of river improvements.

232. (Mr. *Hume.*) Having considered that subject, are you aware of any objections having been urged to Mr. Walker's plan being carried out?—I believe there is a difference of opinion prevailing among scientific men, as to the effect of displacing so much tidal water as it is assumed would be displaced by carrying out the improvements; but that is an objection on which I do not express an opinion; it is said that by deepening the bed of the river, compensation will be made for the tidal water displaced.

233. Have there not been objections made by the occupiers of houses, on the ground that the deepening in the centre will sweep away or interfere with their houses and wharfs?—Not when the plan came to be explained to them. I have heard objections raised by persons who did not understand the principle; but when they found that the plan involved a secure footing of the shore, that objection was removed.

234. Are there any means which you could suggest for facilitating the execution of this work?—I have no doubt that the Solicitor to the Crown and the Solicitor to the Corporation could, if they were authorized to consult together, find some mode of facilitating it. While the suit is pending I can see no possibility of the Corporation doing anything effectually to carry out Mr. Walker's plan without the aid of Parliament.

235. But you do not see any difficulty in meeting the Solicitor to the Crown, with a view to provide a temporary measure, pending the dispute as to the bed of the river?—I have no authority to treat upon the subject; but I think if there was a disposition on the part of the Crown to enter into such a negotiation, I could obtain powers to negotiate.

Mr. *Pemberton.*

236. (To Mr. *Pemberton.*) Are you aware of any and what funds that could be available for executing Mr. Walker's plan?—I can hardly say that I am aware of funds available for the purpose; but the view I take of it is this: the same charters, which granted to the Corporation of London the conservancy of the River Thames, also granted them metage, and a variety of other tolls and dues, to the amount that has been mentioned, say 50,000*l.* per annum. I conceive that the Corporation are bound, out of those funds, to pay the expenses of improving the river; and I conceive that the shores of the river belong to the Crown, and all monies arising from embanking, or from giving leave to embank on the shore, are the property of the Crown and not the property of the Corporation, and are not applicable to the improvement of the river.

237. Are the Commissioners to understand, that you consider the proceeds of the sale of land ought not to be applicable, but that the dues arising from cargoes brought on the river would be applicable to the improvement of the river?—Yes; that is the great difficulty to determine from what fund the expenses are to be paid. I do not think there would be any difficulty in providing for the execution of Mr. Walker's plan, if Mr. Walker's plan has been approved by the Government, a fact of which I am ignorant; if it has, I think that the plan

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might be carried out, if we knew from what fund the expenses would be paid; but I think the Commissioners of Woods and Forests would scarcely be prepared to assent to the proceeds of the sale of lands being applied to that purpose.

238.—Do you consider that the money obtained from the raising of ballast from the river, might be applied to that purpose?—I think the Trinity House hold the rights of ballast under special grants from the Crown, and I apprehend that we should have no right to make the Trinity House pay for the ballast which they are entitled to take under those grants. I look upon the gravel within the particular parts to which the grants extend as being the property of the corporation of the Trinity House.

Mr. *Pearson.*

Mr. *Pearson.*—This is the first time I have heard the claim which Mr. Pemberton now puts forth as to metage dues being applicable to the improvement of the port.

Mr. *Pemberton.*

Mr. *Pemberton.*—I am not speaking of the metage of coals, that is specially appropriated by Act of Parliament.

239. You refer to the other sums levied under the charters?—Yes.

Mr *Pearson.*

Mr. *Pearson*—Then instead of 50,000*l.* a-year, it is about 10,000*l.*; for I included coals. I may state that this is the first time that I ever heard the opinion advanced, that those dues were applicable to the improvement of the river.

Mr. *Pemberton.*

240. (To Mr. *Pemberton.*)—Do not you consider that the penny a ton reserved for metage ought to be applicable for the purpose of improving the river; has that been considered as an available means for the improvement of the river?—Not for the improvement of the river; whatever is to be got from the coal duties, we have looked to as applicable to improvements in the streets of the Metropolis.

Mr. *Pearson.*

Mr. *Pearson.*—The recital of the Act is to that effect—for local improvements, if the locality is too poor to carry them out.

Mr. *Pemberton.*

Mr. *Pemberton.*—With regard to the simple removal of shoals, that I apprehend might be done without any Act of Parliament. The Crown has never interfered to prevent the City from removing shoals,—I think the Crown would be prepared at once to grant licences to the City to remove all the shoals.

Mr. *Pearson.*

241. (To Mr. *Pearson.*)—Has the present amount of expenses on the shipping of the Thames come under your consideration, with a view to see whether any and what reduction could be made?—I have made at various times inquiries of the mercantile interest and the wharfingers; and I am led to conclude that the business of the port of London is better and more economically done than in almost any port in the kingdom. With regard to some of the changes, I have had occasion to know that the railroads now are competing successfully with the coasting trade in the Port of London, and I have ascertained that even if the Corporation would give up its metage altogether, if the fellowship porters would give up their privileges, if the wharfingers would abate 33 per cent. of their charges, and the lightermen 33 per cent., still we could not stand the competition with the railroads in many departments. I allude particularly to the importation of malt from Ipswich, Yarmouth, and Norfolk generally: that was all brought coastwise; it is now brought by the Eastern Counties Railroad; and, finding that our own revenue suffered, and finding that the interest of the river suffered also, I made many inquiries, and the result of those inquiries was, that even if we were to reduce the river charges in the degree I have stated, and the Corporation were to abandon its metage altogether, we could not compete with the railroad.

242. Then will there not be a diminution in the amount of the dues payable on the importation of those articles?—Yes, there will be a falling off in amount.

243. Are any measures being taken, or are any arrangements being made, in order to effect those reductions which you have alluded to?—There have not been any arrangements made. I understand from the parties interested, that they cannot retain this portion of the coasting trade, and I believe the greater portion of it has gone now from the City, the greater portion of the malt certainly.

244. Could you furnish us with a list of the charges now levied on vessels delivering coals, corn, foreign produce, and other articles?—I do not know of any charges beyond the metage charges; the market duty, which is a penny a ton, expires this very year.

Mr. *Pemberton.*

Mr. *Pemberton.*—There would be no difficulty in carrying out the object, except with regard to funds; I should say that what has been done in the river Mersey forms a very good precedent for what ought to be done here; three commissioners are appointed for the river Mersey, who act as conservators, and the Corporation of Liverpool pays the expenses.

Mr. *Pearson.*

Mr. *Pearson.*—No observation that I have made involves the supposition that the Corporation will ever be willing to give up the conservancy of the river.

245. (*Captain Washington.*)—Do you think that the appointment of a Queen's Superintending Harbour-master would interfere with the conservancy of the river by the Corporation of the city?—Is that to superintend the Harbour-masters appointed by Act of Parliament.

446. To superintend them so far as to see that they thoroughly do their duty for the benefit of the navigation of the river?—If the present harbour-masters do not do their duty thoroughly, they ought to be removed; and the Trinity House has power, if any complaints are made against them, to remove them. In answer to the question of what funds I look forward to, which might be applied to the improvement of the river, I should remark, that I think licensing the erection of steam-piers, and levying a reasonable toll, to be settled by Parliament, would afford means for improving the river, instead of allowing private piers, or corporation piers to be erected, for the benefit of particular individuals; any measure that might be in contemplation for the improvement of the river should include a small toll on steam-boat piers, and that would be a source of very considerable revenue applicable to the removal of the shoals and mud banks, and to the repair of the shores which are undermined by the action of the steam-boats in the river.

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In reference to question 183, p. 11.—"And these defendants, not waiving their said demurrer, but relying and insisting thereon, and saving and reserving to themselves all and all manner of benefit of exception, for answer to such parts of such information as are hereinbefore referred to and excepted, say that the embankment at Rotherhithe mentioned in the said information has been completed: And these defendants deny, to the best of their knowledge, information, and belief, that such embankment is or will be detrimental to the river Thames, or a nuisance or injury to Her Majesty's subjects navigating the same; and although these defendants admit that such embankment will, to a very small extent, narrow the water-way, yet these defendants deny that it will incommode the navigation of the said river, and they say that such embankment is in a part of the river where, before the making thereof, the shore or bank was very irregular, and where the river is sufficiently wide to allow the said embankment to be made to correct such irregularity, without detriment to the water-way, and with benefit to the navigation; and notwithstanding these defendants admit that such embankment has a tendency to create a slight eddy at each end thereof, and a slight deposit of mud immediately adjoining thereto, yet these defendants say that there was, before the making of such embankment, a greater eddy and a greater deposit of mud on the shore of the said river at that spot, and that, since the making of such embankment, the accumulation of mud on the shore has considerably decreased; but save as aforesaid, these defendants deny, to the best of their knowledge, information, and belief, that such embankment will produce an eddy at each end thereof, or a deposit of mud in those parts of the river which are adjacent to the said embankment: And these defendants deny, to the best of their knowledge and belief, that such embankment will tend to produce shoals in any parts of the said river below its locality, by excluding a quantity of tidal water essential to the scour or preservation of the depth of the said river; and these defendants say that, by the excavations in the bed of the river, both above and below low-water mark, which have been made, by the removal of the shoals and otherwise, since the commencement of the embankment, in the said information mentioned, a greater portion of tidal water is allowed to pass up the said river than the quantity displaced by all the said embankments in the said information mentioned: And these defendants say they are informed and believe that, since the making of the said embankment at Rotherhithe, the water-way in the said river has been considerably enlarged by the improved scour of the said river, about a quarter of a mile below the said embankment, where the enlargement of such water-way was greatly needed: And these defendants say that the said embankment was made in conformity with a line laid down upon a map, and in accordance with a plan which had been prepared by Mr. James Walker, the civil engineer, who was intimately acquainted with the said river, having for many years conducted some of the principal engineering operations thereon for the Government boards, as well as for various public bodies and private individuals; and that such map and plan were so prepared with the assistance of the harbour-masters and the water-bailiff of the port of London, and also under the personal inspection and with the entire approval of Captain Bullock, one of the hydrographers of the Admiralty, who had been for several years previously engaged in taking the soundings and making surveys of the said river for His late Majesty: And these defendants say, they are informed and believe that it was the object and effect of the said plan to remove the irregularities and curves existing in the shores of the river, to secure the subsoil of the banks from being undermined and drawn into the river, to remove the shoals and sand-banks, and, by excavation, to render the bed of the river of a more uniform depth in the centre, gradually diminishing towards the shores on each side, so as to let the water ebb out lower, and thus increase the space for the admission of a larger portion of tidal water, whereby, as these defendants are advised and believe, the shores of the river will be better cleansed, and the accumulations of shoals and sand-banks will be prevented."

[*The Witnesses withdrew.*]

Adjourned.

Thursday, 12th February, 1846.

Present :—

Rear-Admiral BOWLES, C.B., in the Chair.

Mr. HUME, M.P.	Mr. GODSON, M.P.
Sir GORDON BREMER, K.C.B.	Captain BEAUFORT, R.N.
Mr. CHAPMAN, M.P.	Captain WASHINGTON, R.N.

Captain William Kimin Maughan, examined.

Captain William Kimin Maughan.

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447. (*Chairman.*) What is your occupation, and place of residence?—I am principal Dock Master of the London Docks, and reside at the Shadwell entrance.

448. How long have you been practically acquainted with the Thames?—About forty years.

449. Does any inconvenience arise from a small depth of water in the river in the low water spring tides, or from the shoals between London Bridge and Barking?—There is an inconvenience to steamers of a large draught of water in navigating at low water.

450. (Mr. *Hume.*) Would not great facility be afforded to the general shipping, if the draught of water in the Thames was at least 12 feet throughout at low water?—As far as the Docks are concerned, the river is quite deep enough to admit any vessels to come up before the East India or any other of the Docks could take them in; therefore there is no inconvenience from the depth of water in the Thames as regards the Dock traffic. As applicable to colliers, even if there

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was sufficient tidal water to enable them to do it, I apprehend that they would not attempt to navigate against the tide upwards.

451. Not with a favourable wind?—I think not.

452. Could not they move at the first of the flood?—They do so now, large vessels of 15 or 16 feet, because before the flood tide is made, the water has flowed sufficiently to permit them to pass over the shoals.

453. (*Chairman.*) What are the inconveniences which steamers meet with?—Limehouse shoal up to the present time has been the great inconvenience; they have not had above seven or eight feet of water there. But there is one thing that I may observe, that the water ebbs out more than it did previously to the removal of Old London Bridge.

454. (*Captain Washington.*) Are not the shoals, therefore, a greater inconvenience and obstruction than they were before?—Yes.

455. (*Chairman.*) And that is an additional reason for removing them?—Yes, that is the reason, I apprehend, why they are removing Limehouse shoal.

456. Are you not aware that there are other shoals besides that of Limehouse Reach?—Yes, but that is the worst one.

457. Are you of opinion that the state of the river, as to the maintenance of its present depth, is chiefly due to the freshes that come down or to the tidal waters which daily pass to and fro?—Certainly the freshes that come down will aid it, but I consider that they would not be sufficient without the tidal waters: that that is the great cause of the depth being maintained.

458. Are you aware of the proposal for embanking the upper sides of the river between Vauxhall and Waterloo Bridges?—I am.

459. Are you of opinion that such embankment would cause a decrease of the tidal waters?—I certainly should object to any obstruction of the tidal waters. I do not know whether it is contemplated to interfere with the water of the Thames, but I have a strong objection to any interference with the tidal waters.

460. (*Captain Washington*) You would lay down as a principle, that all interference with the tidal waters is bad?—Certainly; there can be no question of it.

461. You were examined before the Metropolitan Improvement Commissioners?—I was.

462. And your evidence went to show that great mischief might be done in the upper part of the river by excluding the tidal waters?—Yes, that is my opinion.

463. You think it desirable to preserve the tidal waters in every possible way for the benefit of the scour?—Yes, unquestionably.

464. Do you not think that if the waters were properly directed, they might sweep away the mud at the entrance of the quays and docks?—I have no doubt that it would be very possible to have such a tidal scour, that all the shoals in the river might be taken away with a little assistance. I may mention, that a float put in at London Bridge reached to a little below Woolwich in the course of one ebb tide. It is very possible that if the sewerage were carried down to the Isle of Dogs the River Thames might be wonderfully advantaged by that I suppose there is some possibility of that being done.

465. How do you suppose that, it would advantage the river?—The immense quantity of street gravel and soil that is now carried into the Thames would be dealt with as manure.

466. Are you of opinion that the present sewerage is carried down only as far as Woolwich Reach, and that it returns with the flow of the tide?—It certainly goes up as well as down; one ebb tide carries it down as far as Woolwich. But the duration of the ebb tide is seven and a half hours, flood tide barely five hours.

467. Are you of opinion then that the accumulation of mud off Woolwich Landing Stairs is partly to be attributed to the sewerage of London?—I should think so.

468. Have you ever turned your attention to the point how far it would be possible to have such a current as should sweep it away?—No, except by a larger body of water passing down.

469. (*Chairman.*) You have never turned your attention to the direction of that body of water in such a manner as should produce the effect?—No.

470. (*Captain Washington.*) Have you not heard complaints from the owners of steamers and other large vessels of delay in getting up to London Bridge?—Yes; that with vessels drawing 12, 13, and 14 feet water, they could not get through Limehouse Reach at the time of ebb.

471. Is not that a great inconvenience to the trade?—Yes.

472. Are not many mails brought up by the Northern steam-vessels?—Yes, but in case of need they land the mails at Blackwall.

473. In the event of the embankment which you have seen marked out on the plans being carried out on the side of the river, do you think a compensating reservoir should be made above that point?—I do.

474. So that no reduction in the amount of the tidal waters should take place?—The space taken from the river by embanking should, in my opinion, be fully made good by a reservoir: in that case there would be no encroachment at all.

475. Are you of opinion that having a line of quays fronting the river would be an improvement to the river?—I do not think it would, because they would take away so much tidal water.

476. But if compensation were given by the water going under those quays, or there were a a reservoir above, do you not think that a direction being given to the current would be beneficial?—It would not be beneficial in this respect, that the bights that exist now are very important places of security for the craft and barges; and supposing you had a wall up and down the river on both sides, it would be impossible to keep vessels in the river when there was ice.

477. Have you seen the river encumbered with ice to such an extent as to interfere with

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vessels?—I have seen every ship driven out of the river and driven on the ground by the pressure of the ice. On the last occasion, on the 8th February, 1841.

478. You think that those different inequalities along the river would be very beneficial in such cases in allowing the vessels the opportunity of escaping?—I do. I do not know what would become of the river if the proposed embankment was carried out. I stated in my former evidence, that I had observed there was not a single vessel remaining in the pool, and had they not had those bights to go to, they must all have been lost, or seriously damaged.

479. You still retain the opinions expressed in the evidence which you gave in the year 1843, before the Metropolis Improvement Commissioners?—I do.

480. Have you superintended a series of tidal observations in relation to Sheerness and some other points of the river?—I superintended my own observations, and they are printed with the others.

481. Are you aware of any particular results having been ascertained from the taking of those observations?—The results show that the tide at Chelsea Water-works rises nine inches higher now than it did before the removal of Old London Bridge: that was a fact I did not know at the time. I gave my evidence before the Metropolitan Improvement Commission.

482. From the tables that you put in before the former Commission, it results that since the removal of Old London Bridge, the fall of the extreme tides below Trinity standard is 2 feet 9¼ at the London Docks?—Yes.

483. And the rise of the extreme tides above Trinity standard is 1 foot 8¼?—Yes.

484. Therefore the whole range of extreme tides now beyond an 18 feet tide is 4 feet 5½?—Yes; and the average range of tides, beyond an 18 feet tide, is 1 foot 6 inches.

485. Has not the increase in steam traffic been very great?—Yes.

486. And is it not increasing both in the draught and the size of the vessels?—Yes, I believe so.

487. Is not that an additional reason for deepening the river?—Certainly.

488. Is there a self-registering tide gauge at the London Docks?—No; only a float which rises and falls with the tide, but does not register itself.

489. Looking at the importance of the tidal waters to the preservation of the channel of the river as you have yourself stated, is it not desirable that as accurate an account of the tides as possible be kept?—I think so.

490. Are you aware that at Sheerness, Harwich, Scarborough, and many of our smaller ports, such self-registering instruments are in constant operation.—I have understood so.

[*The Witness withdrew.*]

Adjourned till Wednesday next at 1 o'clock.

Wednesday, 18th February, 1846.

Present:—

Rear-Admiral BOWLES, C.B., in the Chair.

Mr. Hume, M.P. | Captain Washington, R.N.
Captain Beaufort, R.N.

Mr. *Nathaniel Knight*

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Mr. *Nathaniel Knight* examined.

491. (*Chairman.*) Will you state your occupation and place of residence?—I am a Trinity House pilot, residing at Stepney.

492. How long have you been a pilot?—About 18 year. I have used the navigation of the Thames 32 or 33 years.

493. Have you been practically acquainted with the navigation of the Thames during that time?—I have.

494 Does any inconvenience arise from the small depth of water in the river at low spring tides owing to the shoals and banks between London Bridge and Barking?—Very great inconvenience. There is a very slight quantity of water for ships of any draught.

495. Will you state the nature of that inconvenience, and how far it impedes the navigation?—It impedes all the navigation at low water for ships of more than 10 feet water.

496. Will you state in their order what the shoals are which so impede the navigation?—Beginning below, in Erith Reach. the first shoal is the Rand Hill, about 15 miles from London Bridge; I have seen as little as six feet water upon that shoal.

497. What extent of the bed of the river does it occupy?—It occupies about a quarter of a mile in the very centre of the river; it is a middle ground; there is a channel on each side of it. Ships frequently ground upon it, especially in turning or working up.

498. Is it a stone bottom?—It is a gravelly bottom. The next is Erith Shoal, 13 miles from London Bridge; it runs off from Cold Harbour Point half way across the river from the north side, and at low water there are about seven feet water upon it. It is sand, and the sand-barges work upon it for the use of buildings. The shoal from Julian Tree is the next; it extends about a quarter of the distance across the river, and on that shoal ships ground very frequently, and sometimes receive permanent damage. The next, at about 13 miles from London, is Half-way Reach. This reach is shoal almost all the way across. The nine feet edge of Dagenham Shelf—the spit and shoals—extend nearly half across the river from the north shore. Have known vessels frequently to ground on them. Then we come to Barking Shoal, which is one of the worst shoals, and the greatest obstruction in the river; it lies a mile below Barking Creek, in the middle of the river, and has only nine feet water over it at low water springs: it is, I believe, of gravel. The next is Barking Shelf, about half a mile higher up.

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It spits out from the north shore, at Barking Point, very nearly the whole way across the river; it is the worst shoal in the Thames, and lies only 1½ miles below the Royal Arsenal, at Woolwich.

499. What is the depth of water at the different places on that shoal?—The shelf itself partially dries, the only channel that you can pass through there is the Cross Channel.

500. At what time of the tide are vessels of the ordinary draught, colliers for instance, able to pass that?—They ought not to attempt it till two hours flood.

501. If that shoal were removed there would be no impediment to their moving at low water?—There would not in this part of the river.

502. (*Captain Beaufort.*) When you speak of colliers, what is the usual draught of those colliers?—14 or 15 feet.

503. (*Captain Washington.*) At low water springs, what is the depth of the best passage? —I have seen vessels ground at 11 feet, even in the best channel when crossing it.

504. Have you ever known the Royal Yacht detained in the river and prevented coming up in consequence of that shoal?—Yes; on returning from Scotland in 1844, with Her Majesty on board, we had to slacken our speed and to wait for the tide flowing, an hour and a half or two hours.

505. Did you so wait in consequence of the want of water in Barking Shelf?—Yes, and lately in coming up with the *Forth*, the West India mail steamer, which was drawing 14 feet of water, we were obliged to wait an hour and a half till the flood, and then she grounded in the channel between the shore and the shelf.

506. How long did she remain aground?—I should think 20 minutes.

507. Did she receive any damage?—She rubbed some copper off.

508. If it had been blowing hard at that time, would there have been any damage to the vessel?—I think it very possible that there would, as a steamer, from her length and weight of machinery, more than any other vessel, is liable to strain herself.

509. (*Captain Beaufort.*) Of what is that shelf composed?—Of hard shingle.

510. (*Chairman.*) What is the next impediment?—The spit above Barking Creek, which extends about 1½ cables' length from the north shore.

511. Have you known vessels ground there?—Yes; ships going down with a light wind fall upon it with the regular set of the tide. The next impediment is on the opposite side, off the point at Margaret Ness, which extends one-third across the river, and a little below this shelf, in mid-stream, are two small hills of nine feet each.

512. What is the next shoal?—The next is at Gallion's Point, where a shelf extends from the north shore fully one-third across the river, leaving only a channel of about 1¼ cables wide right abreast the lower part of the Royal Arsenal at Woolwich.

513. In coming upwards, what further obstructions have you?—Ham Shelf is the next important shoal; it is opposite the Royal Dockyard at Woolwich. There is not room to swing a long steam vessel from her moorings without bringing her upon that shelf; it extends downwards for a quarter of a mile, and two-thirds across the river from the north side.

514. You say that vessels cannot swing from their moorings without coming upon that shelf, is not that a great inconvenience to vessels that bring up at Woolwich?—Very great.

515. (*Captain Washington.*) Is it not the case, that in consequence of this awkward shelf nearly all her Majesty's ships of any length when they leave Woolwich, except when the tide is well up, are obliged to drop down to a fairway buoy in order to get away without risk of grounding?—Yes, and are thereby subjected to great inconvenience.

516. (*Chairman.*) Is not the existence of that shelf a great impediment, not only to private vessels but to all public vessels having intercourse with Woolwich Dockyard?—Very much so.

517. (*Captain Beaufort.*) What is the nature of the Ham Shelf?—It is a hard gravelly bottom, like the general bottom of the river.

518. Gravel and peat?—Yes. In fact, the river is very shallow all the way above that.

519. Does not the Shelf called the Ham, and the Horse extend nearly a mile in length?—Yes; and those shoals are consequently a great impediment.

520. (*Chairman.*) What is the next shoal?—The Charlton shoal; but there is a great deal more water there than there used to be; since the colliers lay there, they have caused more water; it used to be a great impediment to ships.

521. How far does it extend into the river from the south side?—About a third across. I should think there is now about twelve feet water there; it used to be much less.

522. (*Captain Washington.*) Is it not a proof that the river might be easily dredged and deepened, when you have the fact that colliers lying there have caused an increase in the depth of water?—Certainly.

523. (*Chairman.*) To what extent is that depth increased? is it throughout the length of the shoal?—Yes; I do not think there is anything less than twelve feet now; and eight or nine was the greatest quantity at one time.

524. What is the next shoal?—There is the Hook, off Hookness, on the north side. It runs a third across the river, and the nine-feet edge extends a third across the river.

525. (*Captain Washington.*) Does not the projection of that point tend to throw the water off the face of Woolwich Dockyard?—Yes.

526. (*Chairman.*) Coming upwards, what is the next Shoal?—Off the Lea there is Bow Creek shoal, but the river there is shoal almost the whole way across; there is not more than nine feet water; that is the deepest water at low water spring tides in crossing there.

527. Proceeding upwards, what is your next impediment?—The Gun Shoal is the most important shoal next; it lies off the West India Dock entrance; it is a very hard rocky shoal, I believe. I have known a great number of vessels ground on it; they are frequently grounding there, and receive damage.

528. How far does it extend into the river?—From the north side it extends about a third

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across the river, but it is not more than three long steamers' lengths. It occupies the whole space between the entrance to the City Canal and the entrance to the West India Docks, with a narrow deep water channel within it. There was an attempt made to remove it with the engines some years ago, but it was not proceeded with.

529. Coming upwards, what is the next?—The channel is very fair between Blackwall and Greenwich, with the exception of the mud that runs out from the north shore. The depth of water on the middle grounds is generally from nine to ten feet, but in the channel on the east side it is 14 feet deep.

530. There vessels must wait till half-tide to pass?—They generally wait in the deep water in Blackwall Reach, not having water in the Greenwich and reaches above. A vessel of 14 feet water must wait an hour and a half or two hours.

531. What is the next impediment?—There is not any particular impediment till you get to Whiting Shoal; that is above the Commercial Dock entrance, but I believe it is partially removed. I understand that there is 13 feet of water in that reach.

532. (*Captain Washington.*) Do you know for what width of channel that is?—I do not.

533. (*Chairman.*) Is there any other shoal up to London Bridge?—Not anything particular.

534. Speaking generally, have you known any loss of property from those shoals during the time that you have been employed as a pilot?—Not as regards any total loss; I have seen a great deal of injury done and delay occasioned.

535. What is the nature of the injury that has been done to the trade?—The danger is that if a vessel grounds as she is going away on her foreign voyage, the underwriters may compel her to come back and be surveyed again.

536. That is applicable to all impediments on the river?—Yes.

537. Consequently it may risk the voyage and create a necessity for overhauling the vessel, and lead to great expense?—Yes.

538. In your opinion, would not the removal of those shoals be of great advantage to the navigation?—Very much so.

539. What facility would it afford to the trade coming up and going down?—Frequently in winter time it would make a difference of a day or two in a vessel's voyage, if it happened to be what we call two dark tides, that is, high water morning and evening before and after day-light and sunset. If the impediments were removed, we could come up at all times, and the river would be navigable for smaller vessels in the night as well as in the day.

540. The great facility occasioned by deepening of the river would be in quickening the time and saving all risk?—Yes.

541. If you were to advise the deepening and the removal of these shoals, what general depth from Gravesend upwards to London Bridge do you think would be the most convenient?—There ought not to be less than 14 feet.

542. Are you able to state what is the average depth of the river where those shoals do not interpose?—There are many places where in the best of the water there is not more than nine feet, through Bugsby's Hole for instance.

543. To what extent does that depth of nine feet go?—To the extent of about half a mile down the reach, but that could easily be deepened.

544. Do you know whether there are any rocky or hard bottoms which would prevent the river being deepened to 14 feet?—Not any rocks; only hard parts, as at the Gun Shoal, and that could easily be removed.

545. You have stated that in one part the water has been deepened from vessels lying there, which do you consider to have the greatest effect on the clearing of the river, the flood or the ebb-tides?—The ebb, and the straightening of the channel would have the greatest effect, and would increase the flow.

546. Since the general use of steam navigation, has it not become still more important that these impediments should be removed, in order to enable steam-vessels to come and go at all times of the tide?—Decidedly so.

547. (*Captain Beaufort.*) Are you aware what the depth of water is over the Tunnel?—I am not.

548. Does it admit 14 feet of water over it?—I think not. I am not aware what quantity of soil there is over the Tunnel. I have not been across it latterly.

549. Have you attended to the depth of water in the river since London Bridge was removed?—Yes.

550.—What has been the effect of removing London Bridge?—The water below the bridge ebbs out more than it did before the bridge was removed as much as three feet.

551. (*Chairman.*) If those shoals were removed, would not the expenses attending the shipping, as regards the navigation of the Thames, by reason of the more easy access and egress, be much reduced?—Yes.

552. And the chance of detention in the winter season would be much lessened?—Certainly.

553. Consequently the economy and safety of the navigation of the river would be much promoted by this being done?—It would.

554. When you speak of straightening the river, what do you mean?—Taking off the points and filling the hollows up, to give a more uniform flow of the tide, which would have a good effect in strengthening the tide.

555. Have you observed the effect of the flood coming up? Does it disturb the mud in the river to a great extent?—I think it is more disturbed by the ebb; it may be the land-water, but it looks thicker.

556. Has the introduction of steamers had any effect upon the bottom of the river?—No; I think not.

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557. Are you aware of any impediments which exist to the straightening the river, and the deepening, which you think would be so useful?—I cannot see any.

558. If the impediments were removed, which you have now pointed out, the facilities of navigation would be very great, and time would be also saved?—I think so.

559. What class of vessels are you employed on generally?—My principal employment latterly has been in the West India Royal Mail steamers, the Peninsular, and the Oriental steamers.

560. The largest steam vessels, in fact, that come up the river?—Yes.

561. What depth of water do they draw?—The West India draw 19 feet when all their coals are in.

562. What time do they generally leave?—In starting from Blackwall, the tide generally flows three or four hours before we attempt to move.

563. You loose, then, three or four hours every tide, which, if those impediments were removed you would save?—Certainly.

564. Have you known any number of vessels ground and injured, and very large expense occasioned by that?—Yes.

565. Do you know of any shoals that have been removed in your time?—No, not any that have been removed; we have more water on some than we used to have.

566. (*Captain Beaufort.*) Where the river has been deepened or shoals have been removed by dredging, have they grown up again?—I am not aware that they have.

567. Then is it your opinion that if a shoal was once removed, the stream would keep the channel open?—I think it would.

[*The Witness withdrew.*]

Mr. *Martin Pratt* examined.

Mr. *Martin Pratt.*

568. (*Chairman.*) You are assistant secretary to the General Steam Navigation Company? —Yes, for eight years.

569. During that time have you had any complaints from the captains or pilots of vessels as to the vessels grounding in the passage up the river?—Frequent complaints.

570. Have you had any complaints as to delay with respect to the mail?—Not so much with the mail, as the departure of the mail is regulated by the state of the tide. Supposing it is high water at four o'clock, the time of departure would be two o'clock, so as to secure high water down the river. It is very objectionable to start with an ebb tide; the navigation of the vessels is more dangerous in navigating with the tide in a narrow channel.

(Mr. *Allen.*) It is more dangerous going with the tide than against it. We consider when we get to Woolwich that we are more out of danger than we are amongst the small craft and boats above.

571. Have you ever forwarded a complaint to the City authorities?—(Mr. Pratt.) No, we have made application to the Trinity House to remove certain shoals, and the answer in most instances has been that the substance taken from the shoals is not good enough for ballast purposes, and therefore they refuse to do it.

572. Have you those letters?—Yes.

573. Can you forward those letters to the Board?—I think it is probable that I can; they are not numerous, but I think I can furnish the Commissioners with one or two answers from the City and Trinity Board.

574. Have you had any other complaints of impediments to the navigation of the vessels?—They are very frequent; the complaints are not made in such an official way; the complaints are daily. It daily happens that vessels are detained.

(Mr. *Allen.*)—Captain Watson applied to the Trinity House three weeks ago, and the answer he received from the Trinity House was, that they would send two lighters, and set them to work; and that if it was found to be good for ballast, they would continue it, but if not, the Company must pay the expense.

575. Are the committee to understand that the Trinity House will not remove any shoal unless it is gravel suitable for ballast?—Yes.

575.* (*Captain Beaufort.*)—When they take up bad stuff, do they ever throw it into the river again?—They get rid of it anyhow. I never saw it landed.

576. (*To Mr. Pratt.*) Have you ever addressed the Trinity House upon the subject of intermediate lights?—No.

577. Do you order the ships that carry the mails to go at half speed down the river?—I do not know that there are any such instructions extant.

(Mr. *Allen.*)—I will tell you what I do; I do the best I can for my employers to avoid damage. At certain times it is necessary to go faster; and at another time, when you see a deep barge, then, to avoid damage and expense, you go easy; and then, as soon as I am by, I go as fast as I can.

[*The Witness withdrew.*]

Mr. *Charles Rowland* examined.

Mr. *Charles Rowland.*

578. What situation do you hold at present?—I am second Harbour Master of the Port of London, and have been so for nearly twenty-five years.

579. Are you practically acquainted with the navigation of the river?—I am.

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580. Does any inconvenience arise to the shipping from the small depth of water in the river ?—Considerable.

581. Will you state what the inconveniences are ?—From the shallowness of the water generally throughout the river, both for anchorage and for the purposes of navigation.

582. Do you speak generally, or of any particular parts ?—I make that observation generally, because some parts are different from others. We have shoals and mud banks in the River, and other inconveniences.

583. Do you berth the vessels ?—The Harbour Masters arrange the vessels in the River Thames.

584. What rules do you observe in berthing them ?—They are berthed according to their draught of water, and the trade in which they are employed.

585. Do you place them in the deepest places along the river ?—The vessels of the largest draught of water are placed in the berths where the greatest depth of water is, and vessels drawing the least water are put in the shoalest water.

586. Do you allude to the colliers particularly ?—To every class of vessels, but more particularly to the colliers.

587. Does not the berthing of the vessels in tiers interfere with the navigation ?—Yes ; it has always been my opinion that no vessel should either lie in the river as a floating warehouse or disharge her cargo in the stream of the River Thames.

588. The pilots complain particularly of two shoals, one lying off Charlton and the other at the west section ?—The west section commences from above the mill in Bugsby's Hole, and extends down to the Ferry House at Charlton ; and the shoals are extensive off Charlton and in Bugsby's Hole.

589. What distance would that be ?—I suppose that would occupy a mile and a quarter in length, and the section is appropriated for 75 vessels.

590. Do they occupy the deepest water in the channel ?—Nearly so.

591. Is there any rule as to laying out anchors ? It has been stated that the anchors are often laid out in the channel so as to endanger the ships passing ?—The anchors are laid out for the convenience of the vessels anchored in the section, and each anchor should have a buoy and buoy-rope.

592. Do not vessels passing, in endeavouring to avoid the shallow water on the opposite side, run the risk of striking the anchors ?—They do, and they keep considerably away from the ships in consequence.

593. Have you known any accidents by vessels running on the anchors so situated ?—Such cases have occurred.

594. Could you not avoid that by having moorings laid down, or some other means ?—Moorings certainly would avoid the necessity of letting go anchors ; but the true remedy is that of collier docks, and removing floating warehouses at once from the stream of the River Thames.

595. Are the Committee to understand that you are of opinion that the colliers, lying berthed as they are, do impede considerably the navigation ?—Decidedly ; the whole of the River is not too wide for the purposes of navigation.

596. And you are of opinion that they ought to be removed to collier docks, so as to keep a fair channel clear ?—Clear for the navigation of vessels passing up and down.

597. If they are not removed, ought not moorings to be put down so as to leave the space between the ships and the shore clear, in order to avoid the danger to which vessels are exposed from the anchors ?—There is considerable danger from the anchors ; but I should say it would be necessary to have buoys to the moorings in the sections, and the buoys themselves would become a nuisance to vessels navigating up and down, when the vessels were removed from the different buoys, and they would become a nuisance generally to the navigation ; but some are convenient to vessels lying in the river, waiting to come into the docks, and for transporting vessels in and out of the docks.

598. You say that in section one 75 lie ; how many sections have you in the river ?—Seven.

599. How many lie in the second section ?—Fifteen.

600. (*Captain Beaufort*). Might not better places be picked out for the sections ?—No. I think the places that have been picked out for the sections are the best that can be found in the river. I will state the sections as they are divided out by the regulations. This is a book which I published on the Laws and Regulations of the Port of London a few years since [*producing the same*].

601. Are they regulations sanctioned by the City authorities ?—No, they are not. I intended to have published them independently of the Corporation of London, but I was advised to see them upon the subject. I had a conference with the Navigation Committee, and the consequence of that conference was that they permitted me to publish them. They thought that it was a work that would be beneficial to the shipping generally; I was only to put my own name to it, but not to publish it as one of the Harbour Masters of the Port of London; by doing so it would make it an official document, which it was considered better to avoid, as all the regulations were published by the Corporation separately.

602. Are those seven sections agreeable to the regulations adopted by the City ?—They are made by the Corporation of London.

603. What number of vessels do these seven sections accommodate ?—No. 1, 75 ; No. 2, Galleons, 15 ; No. 3, North Galleons, 25 : this is a section not used generally for the occupation of colliers, but used for traders as a temporary section, when we know that a day or two will be the extent of time of their lying there. No. 4, Half-way Reach, 25 ; No. 5, Long Reach, 150 : this reach is sometimes used by 200 colliers, in cases of emergency ; No. 6, below Greenhithe, 65 : there is a space in this section that is used for Her Majesty's

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ships, and there the number of colliers is reduced. No. 7, Northfleet Hope; making altogether 430.

604. Have you that number now?—No. I have a document here showing the number that were detained each day throughout the last year; but there is a vast deal of other information with this. It is a return showing the daily duty of my office, which I have kept ever since I had charge of it, from year to year [*producing the same*].

605. Does this give the number of days they were detained?—No.

606. Could you furnish that?—That would be a very extensive document. This column shows the number of arrivals every day at Gravesend; the next, the number of orders I give for my office to the Pool; and thus the number daily in the sections. But I can extract the required information, and give the Commissioners the whole for the last year, or the last month:

" A Return showing the total number of Colliers which arrived in the Port of London, the numbers which entered through the Sections under the authority of the Collier Bye Laws of 1838, and the number that proceeded to Docks and Wharfs directly and without delay.

Year.	Total Number arrived in the Pool. Ships.	Entered at the Harbour Office for Sections.	To Docks and Wharfs without delay.
1839	9,340	8,148	1,192
1840	9,132	8,433	699
1841	10,311	9,604	707
1842	9,691	9,083	608
1843	9,593	8,980	613
1844	9,466	8,648	818
1845	11,987	11,295	692"

607. Will you state what are the principal inconveniences attending the navigation? The want of water is one, the mooring of colliers in the river is another; what other inconveniences are there?—The impediments by shoals.

608. Have you any reports made to you of vessels grounding on the shoals?—I have frequently seen them on the shore, and frequently heard complaints, but the complaints have not been made in a specific form to me as one of the harbour masters.

609. To whom are they made?—If made at all, they are either made to the Navigation Committee, or to the principal harbour master. The pilots, of course, make their complaints to the elder brethren of the Trinity House: the merchants and ship-owners to the Corporation of London.

610. Do you know whether there is a record of such complaints?—In the harbour service Captain Fisher has a minute book, where, I apprehend, it would be noticed, and the same in the town clerk's office, where the documents are registered for the Navigation Committee.

611. What depth of water would be sufficient to enable the ships to pass up and down at half-tide, say vessels drawing 14 feet water?—We have seldom anything above 14 feet navigating at half-tide, as they are compelled to wait for the tide to pass over the shoals, and for water into the docks.

612. Vessels of a greater draught will be obliged to wait till near flood?—Till nearly high water. There is another reason, that, by having a greater depth of water, they can get up with greater certainty to their destination, and they have no time to wait at the dock entrances. If they are early in the tide, there is not sufficient water upon the sills of the different locks to enable them to go in immediately, and therefore, as a matter of convenience, they wait till a late period of the tide.

613. But with vessels going down, would not it be beneficial that they should be able to move at half-tide, or an hour of flood, instead of waiting till the latter part of the tide?—The best mode of navigating ships bound down by steam is decidedly against the tide, for if they meet with any accident or any difficulty in navigation, they can remedy that as the flood meets them, whereas on the ebb-tide they would be obliged to remain at anchor or on the shore until the return of the tide. But ships seldom get into the stream to come down the river till about an hour and a half or two hours before high water.

614. Have you any reports of losses in the river from grounding on the shoals?—I am not aware of any.

615. What suggestions are you able to make as to improving the navigation?—I do not think I can better answer that question than by saying that I was directed, with certain gentlemen (Mr. Walker, Captain Bullock, and several others), to view the port of London generally, and with them to make a general report. I understood that that report was to be a joint report of all the officers that went upon that survey; at least that each officer should make his own report, and that a joint report should be made from their several opinions. But it turned out afterwards that it was not so. Mr. Walker made his report, and I put in mine upon the occasion.

616. Is not that Report printed in the book?—There are many points in the Report which are not mentioned in the printed book; generally speaking, they are the same, but they are given more in detail in the Report I made.

617. Will you state what are the matters left out?—They are simply my reasons and opinions upon various subjects there detailed. It is a condensed Report.

618. Can you give the Commissioners a copy of that Report?—I have made some verbal alterations, but generally the Report is the same.

619. Since you reported in 1842, you having continued in the situation of harbour master, have you anything in addition to add in respect to improvements that might be made?—No; I think this Report will comprise the whole of the matter that was then referred to us.

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620. Have you had any reason to alter any of the opinions then given and reported to the City of London?—No. There is also the subject of piers upon the River Thames which is not touched upon here; but they have increased on the banks of the river to a great extent for public convenience, and require, in my opinion, to be regulated.

621. Is it your opinion still that those shoals and mud banks and rocks, which impede the navigation can be removed as easily as you have stated, and as Mr. Walker has stated in that Report?—I think some difficulty would arise in some parts of the river, but in other parts I think they might be very easily removed. I have brought with me some specimens of the several rocks, if the Commissioners would like to see them. [*Producing several specimens.*] A vast deal has been said about the Blackwall Rock and about the Brocks Bay Shoal, and other places, but I think, when you look at the nature of the rock, you will agree with me that they may be removed; because if the ballast-machine commonly in use will not do it, stampers fixed to the side of the machine would soon crumble it to pieces; as also would horns upon the buckets. The Whiting Shoal is composed of thin hard substances of rock, but mostly a sort of pudding stone; the Alderman's Shoal [*producing it*] seems to be indurated clay. It would appear to have been burnt.

622. (*Chairman.*) Whereabouts is the Alderman's Shoal?—It is off Alderman's Stairs, and towards the St. Katherine's Docks.

623. From the specimens you have now given of the shoals in different parts of the river, do you see any difficulty, if proper machinery is used, in clearing them throughout?—None whatever.

624. Are you able to state whether that is solid throughout, or whether that kind of coating of stone is only a shell over the bottom?—I think it is only a shell over the surface; I think after the crust is broken away the under part will come away very easily.

625. (*Captain Beaufort.*) What thickness?—The thickness over the Blackwall Rock and the middle ground was something like fourteen or fifteen inches. As soon as the crust of the Blackwall Rock was broken away, which was done partly by machine, partly by blasting, it disappeared and now there is no portion of it left. The Whiting Shoal is a very hard shoal, a very difficult shoal. I have seen the Trinity ballast-lighters frequently at work, trying to get hold of it without effect.

626. Have they blasted any part of it?—Captain Fisher exploded some gunpowder upon a part of it, but I do not know with what effect.

627. (*Chairman.*) You have stated in your Report, that although shoals and mud banks have long existed in the Thames, you consider the clay, earth, soil, sand, and rubbish brought into the stream by the drainage and sewerage to be the primary cause of the formation of the shoals?—No doubt. I took an opportunity to take up a quantity of water and allow it to settle down, and afterwards weighed the contents of the sediment, and I have given the result in this Report.

627. You have stated that the thousands of tons of coal-dust and ashes thrown into the river from steam-boats and other vessels seem to you to be a great cause of those shoals that have taken place; are the Committee to understand that that is your opinion?—They have tended to form those shoals; but I should like to make this remark; since that Report was made, a Bill has been passed, called the Ballast Act, in which I took very great interest to have a clause inserted, and since that, comparatively a small quantity of coal-dust has been thrown overboard; the stokers are under a penalty for throwing it overboard; the officers, when they go up and down, stop them from throwing it overboard when they see the practice commenced.

628. Within what limits?—Within this and Gravesend.

629. Where are they allowed to throw it overboard?—Not anywhere; they ought to have barges come alongside the different steam-boats and take it out. It is now the constant practice for boats to come alongside the steam-boats and receive their coal-ashes.

630. You know that, since the passing of the Ballast Act, the refuse of coals thrown into the river has much decreased?—Much decreased.

631. It was stated in that Report that there would be no difficulty in deepening from London Bridge downwards, so as to obtain 12 feet at low water; have you had any reason to alter that opinion?—Decidedly not.

632. It has also been recommended that the banks of the river on each side should be straightened, with the view of giving an easier flow to the tide upwards and downwards; have you any reason to alter the opinion that you gave upon that subject?—None at all; it is fully described in the Report.

633. Have you considered whether it would be necessary to make the walling on each side to high-water mark or to half-flood, or in what way?—I should consider that the whole line of embankment should be brought up to high-water mark. It was proposed by Mr. James Walker that there should be a sort of dwarf wharfing where barges might lie and discharge their cargoes as at present. Of course that would be a great accommodation to the barge trade, but provided collier docks were established, the barge trade would be considerably decreased.

634. Does that plan embrace the removal of Hookness and other points which now impede the flow of the river?—Exactly.

635. So as to render it uniform?—To render it uniform; and direct the set of the tide. By having a free set of the tide, we anticipate a good line of channel, more in the centre of the river.

636. Do you contemplate a uniform breadth or merely a uniform sweep along the banks, leaving the breadth of the river as it is?—The breadth of the river would be left nearly the same for the tidal scour. The object is to avoid the unevenness in the breadth of the river. The river in some places is 880 feet wide; then further on it is 1390. Then again it is contracted

in Blackwall, and in Bugsby's Hole it increases; the effect is, the deep water is found in the narrow part, and shoals in the increased water-way.

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637. You have mentioned in your Report that at Globe Stairs the width of the river is about 880 feet, and at Cuckold's Point it is 1020. "The water confined at Globe Stairs suddenly expands over a broad surface; the tide is deadoned, and eddies are formed at the point," which are the means of forming a shoal. Do you consider that by filling up the hole and keeping the stream alive throughout, you will avoid the reformation of shoals?—Exactly.

638. Is that the principle throughout the whole?—That is the principle maintained throughout the whole of the Report.

639. In your Report you made some comparison between the year 1750 and the present time, as to the depth of water, what is the depth of the river generally now as compared with any former period, either in 1750 or 1796, which has come under your observation?—It appears to me that the general depth of the River Thames has considerably increased.

640. Has it increased since the removal of London Bridge or before?—The removal of London Bridge has increased the depth of water in the channels, but decreased it on the shore. The tide runs out lower now than it did before the removal of London Bridge. The flood tide also rises higher.

641. Have you kept any tide-gauge to ascertain what has been the alteration?—We have no fixed tide-gauge. We have the Trinity marks at each of our offices, and we judge according to the mark, but we have no direct gauge.

642. Since the general introduction of steam navigation, which, as you have observed, is a new feature, is the deepening and the clearing of the river more important than formerly?—No doubt of it.

643. What has been the effect generally of the introduction and use of large steam-vessels on the shoals of the river?—It appears to me that by the wash of the steam-boats along the river there has been a vast alteration in the quantity of mud deposited upon the shore. The steam-boats have tended in a great measure to keep alive the silt and other matter in suspension, and it is kept upon the move by the tide, and by that means they have tended to deepen the channel of the river. I will give a particular instance before my office at Greenwich. When I first came to the office in 1832, the shore had between four and five feet depth of mud upon it, and in order that we might launch our boats when the tide was down, we we recompelled to have skids laid that the men might not get up to their middles in mud. Now the whole of the mud is removed, and we are obliged about every fortnight to remove from our causeway the shingle which is thrown up by the wash of the steam-vessels.

644. *(Captain Washington.)* Where does that gravel come from?—It comes from the shore of the river; and upon the opposite side of the river, instead of coming out a considerable depth in the river, as it used to do, it is now deepened, and almost close alongside the low water-mark in some places we have 13 or 14 feet water.

645. You consider that no permanent benefit to the river can take place without dredging and removing the material that now forms the shoals?—I do.

646. *(Chairman.)* Since you have been harbour master, have any dredging-machines been employed by the City until they began to remove the Whiting Shoal?—The first was the removal of the London Bridge Shoal. There was formerly a shoal of a very extensive kind immediately below London Bridge.

647. Do you remember when that took place?—As long as I remember the port of London the shoal was there. It was removed immediately after the removal of London Bridge. There was some attempt made to remove part of the Alderman's Shoal off St. Katharine's. It was done by the representation of the Corporation of London, through Captain Fisher, to the Trinity House, and latterly the City of London have been at work upon the Whiting Shoal. The Trinity House removed Cooper's Shelf in Woolwich Reach, there is now 17 feet water where the shoal was.

648. The St. Katharine's Shoal was removed by the Trinity House?—Yes, partly, at the solicitation of the Corporation of London.

649. Do you continue of opinion that, by the use of dredges, 12 feet water may be obtained from London Bridge downwards, and that if there were a general embankment of the river as far as the tide flows, so as to give a precise line for the ebb and flood, that would, by equalizing the depth of the river, increase the depth, and assist to keep the river clear?—I do.

650. After all the experience that you have had, that is your opinion?—Yes.

651. And that if that were done, the impurities and the shoals now deposited in holes in the river would be carried out to sea, and that the navigation of steamers and other vessels, at different times of the tide, would be very much facilitated?—Certainly it would facilitate the navigation of the river.

652. Have you considered what would be the effect on the river below of deepening the river from London Bridge upwards?—I consider that the same system would operate there as below the bridge; that by confining the river in some parts where the river is exceedingly wide, and by making it one uniform width, or nearly so, the channel would be improved, and a navigable channel would be formed, which is not the case now.

653. You would carry the same principles which you apply from London Bridge downwards upwards also as far as you can?—Yes; I have not had much experience above London Bridge.

654. In the dredging you have seen, what rule has the Trinity House observed with regard to removing the shoals?—I have known from experience, that when they have been applied to for the purpose of removing any particular shoal, or unevenness in the bed of the river, they have invariably sent their ballast-machine to the spot, and lighters have been engaged upon the place. If they have found the material fit for ballast, they have continued the work; if, on the contrary, it has not been fit for ballast, they have discontinued it, and gone to other places.

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655. Leaving consequently the mud and peat, and other matters, which equally impede the navigation, untouched?—Yes.

656. Have you observed whether, in raising ballast, they attend to the object of making and leaving a uniform surface at the depth, say of 12 feet, or whether they do it in such a way as to make holes in raising the gravel?—In raising ballast by manual labour, it is impossible to raise it otherwise than by holes; the method of proceeding is by a scoop, and they must first work a hole before they can get the scoop full of ballast, and it is the constant working in this one hole that enables them to get the scoop full of ballast. I have been on board the ballast-machine at Barking Shelf, and opposite Dagenham, and I have seen them slack the chains, and the lighter has been moved from spot to spot.

657. By that means they have taken an uniform depth along the whole shoal?—I will not say an uniform depth, but they have not always worked in the same hole, they have varied the working of the shaft.

658. Do you see any difficulty in their working so as to leave an uniform bottom?—No; but they would not get so much ballast; the deeper the hole, the better and cleaner the ballast, and the buckets are filled with ballast.

659. In this Report which you have made, do not you contemplate obtaining a smooth bottom, and the avoidance of those holes?—I should say, that unless the bottom was rock, if the bottom was of shingle or sand, or any loose material, those holes would be of little consequence, because, as the tide passed over the surface, the stones, which are always upon the roll, would fill up those holes, and uniformity of surface would be the consequence.

660. And that is the object you look to?—Yes; if it was rock, it would be a different thing, and artificial means must be used to break the surface.

661. What observations have you to make respecting piers?—Simply that they have been temporarily permitted by the Corporation to be run out for public convenience from the different stairs and places, and I consider that some uniform system ought to be adopted in their construction and management, both up and down the shores of the River Thames.

662. What is that system?—That system was to maintain the same line as recommended by Mr. James Walker and the other officers, that no embankment, whether temporary or otherwise, should exist beyond the line laid down, and that if it was necessary for public convenience that wharfs should be established at particular places, they should be of a permanent kind, and that the water should be brought to the piers, and not the piers to the water.

663. With the view of keeping the space of water-way clear?—Yes, and keeping also, the proper run of the tide; where you have three, four, or five barges run out from the shore, projecting in some places two or three hundred feet into the river, it is evident that barges and boats cannot pass freely, and if they travel on the outside of the piers, they are in danger of coming in contact with the steam-boats.

664. In expressing an opinion that the colliers should be removed from the stream, do you extend that opinion to the removal of all barges also from the stream of the tide?—No, the barges go almost as a natural consequence with the colliers; but when once collier docks were established, and the vessels were not permitted to discharge their cargoes in the stream, then wharfs and depôts would be established on both sides of the river and in the docks, so that there would be land carriage at once without the use of barges.

665. (*Captain Beaufort.*) If those embankments were formed which you have spoken of, and made into wharfs, would that be sufficient for the steam-vessels without making any jetties?—If an uniform line of embankment were established, then there is no question that the depth of water would be sufficient for vessels to go alongside, and if not it could be made by dredging.

666. It would be possible by that means to keep the water alongside sufficiently deep without any projecting jetty?—Yes, the same as at London Bridge Wharf, Brunswick Wharf at Blackwall, and the pier at Greenwich, before it fell inward.

667. (*Chairman.*) Is there any means, from time to time, used to keep a sufficient depth of water, or is the depth of water secured by the scour of the stream?—It is secured by the scour of the stream. At the Brunswick Wharf there is a great depth of water directly upon it.

668. Is there any tide opposite to it which sets the water directly upon it?—Yes; there is the Brocks Bay Shoal, and a narrow channel formed between it and the Bow Creek Shoal upon the opposite side, which throws the water directly on to the Brunswick Wharf, and maintains the depth of water.

669. Then the result of your observation and experience is, that all the shoals might be removed and the banks of the river made uniform, and that that would answer all the purposes of the navigation?—I think it would if it were once deepened.

670. In your Report you stated further, that a light on Blackness Point, opposite Grays, would be of great service to all vessels navigating at night. What is your opinion upon that subject now?—My opinion is still stronger upon that point; I have seen several vessels aground at that point. We find, that in a moderately dark night, or with a lofty flood, it is impossible to see the point. The water flows a foot or two over the point itself, and it is hidden at spring tides. The Trinity House have placed beacons, but they are not discernible at night.

671. You consider it desirable that a light should be placed there?—Yes.

672. Is there anything else that you would recommend to improve the navigation from the Nore upwards?—I have generally confined my remarks to the district under my immediate control, between London Bridge and the Hope Point. I am generally acquainted with the river below, but I have not devoted my attention to that so particularly.

673. (*Captain Washington.*) Have you known many vessels go upon this Blackness Point?—I have seen several vessels there.

674. What is your opinion as to a light at Shellhaven?—At Shellhaven a light might be useful as a leading mark out of the Hope and down Sea Reach.

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675. Does not the Bligh Sand extend from the south shore even more than the Broadness does from its shore into the river? and do not vessels commonly get aground upon that sand?—Yes; there was one when I was there last summer, a vessel called the Merchant, of Newcastle.

676. (*Captain Beaufort.*) With respect to the comparative depths of the water now and formerly, by what map or chart are you able to make a distinct comparison?—We have a chart made in 1750, and I have my own soundings here taken in 1825 [*producing the same*].

677. Have you anything much older than that?—I think I have one of Charles the Second's time of Woolwich Reach, but it is impossible to say what was the standard then, by that chart the greatest depth of water marked was 17 feet. This was a little plan I sketched out to give an idea of the several shoals of the river [*producing the same*].

678. (*Captain Washington.*) Does not the scouring of the docks into the river cause a great deposit of mud?—Yes; a quantity of mud is formed in the docks, and brought out in barges and thrown overboard; it is professed to go upon the Isle of Dogs, but one-half of it goes overboard. The Corporation of London have taken great pains to prevent it; they have sent inspectors and offered rewards for the discovery of offenders, and prosecuted many persons.

679. (*Captain Beaufort.*) Are there any great sewers from which a vast quantity of mud issues?—Yes, the large Kent Sewer, the Limekiln Dock, Deptford Creek, and others.

680. Does much mud come out of the River Lea?—A vast quantity out of the River Lea.

681. Do you think it would be possible to carry out Sir Frederick Trench's plan of having a depôt for mud at the east end of the river?—It would be very difficult of accomplishment.

682. (*Captain Washington.*) You have said that you would recommend the river being embanked on both sides above London Bridge as well as below; would not that be the means of excluding a great deal of the tidal water, and would not that be an evil?—I do not know that it would, because the tide would flow quicker when it was confined to a certain line, and that line will not decrease the section of the river in the narrow parts.

683. Does the tide rise higher and fall lower since the removal of London Bridge?—Yes; there is between two and three feet difference.

684. What do you judge of that by?—By my observation upon the river. Those parts of the river which I used to consider the low-water marks are now left high and dry; we have also a tide-gauge which shows it with the Trinity low-water mark. The chart which I have produced was taken in 1825, according to the Trinity low-water mark.

685. You mean by the Trinity high-water mark?—We have a low-water mark as well as a high-water mark; we have one nearly abreast the Whiting Shoal, and marked "Trinity low water," a large granite stone sunk, about four or five feet in the shore, with the upper surface or the Trinity low water-mark.

686. (*Captain Beaufort.*) In the examinations you have made about the alterations in the Thames, have you ever discovered that there was formerly a tide-gauge kept at any part of the river?—No, I have not.

687. (*Captain Washington.*) And at this time no one connected with the port of London, under the Corporation, keeps a tide register?—I believe not. We have no premises on which a gauge could be fixed for high and low water.

688. In fact the only tide-gauges kept on the river are kept by the dock companies?—Yes, by the dock companies. [*The Witness withdrew.*]

Mr. *Robert Rettie,* C.E., examined.

Mr. *Robert Rettie,* C.E.

689. (*Chairman.*) Are you a civil engineer?—I am.

690. From Glasgow?—From Glasgow.

691. What is your occupation?—Since 1840 I have been entirely engaged in scientific pursuits, inspecting public works, and everything connected with machinery, and the improvement of lamps, burners for gas and oil, and for light-houses and railways, &c. &c., and of the mechanical arts; in fact, generally speaking, almost everything connected with models and machinery. I have also been engaged the last 20 years on my own account in the general brass founding and finishing line, in which I have come in contact with and supplied many engineers throughout Scotland and England, especially in the manufacturing of general brass and iron machinery, &c.

692. Have you prepared some lights for this Board?—Yes; the new tidal harbour light, and I have been engaged the last 15 years in the manufacturing of signal lights suitable for railways, piers, harbours, &c.

693. Will you state what is the nature of the advantages you contemplate from them?—The first thing which drew my attention to it was with regard to railways. The signal lights for night, and also the day signals, those they are now using, were originally my invention, and which have been the means of preventing many accidents; and many of the accidents that have arisen are from not attending to the lights, and their not being at the trouble to light them, and by their intrusting them to careless servants.

694. What is the advantage of yours as compared with former ones?—The intensity of light, and the management of the burners, using proper reflectors, and bringing a perfect colour therefrom, and also so simplifying the whole arrangements, by making one lamp do where they now on some lines use three or four lamps; therefore, by my system, I enable one man to attend more correctly and with certainty of effect, because less complex in the plan, quicker in action, and not liable to go wrong or to be misapplied, and my arrangements are entirely different from those which are now in use by any other party, though they have used part of my system, as to the colours.

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695. You disapprove of the lights hitherto in use?—Yes; being too numerous and complex in their arrangements, and not nearly so effective in the light as they ought to be.

696. (*Captain Washington.*) Can you apply your system to light-houses round the coast as well as other purposes?—Yes; everything connected with light-houses, harbours, or ports may be much simplified and made more decidedly useful than they are at present, so that *no mistake could be made.*

697. (*Chairman*). What would your remedy be?—By a new system of burners with proper reflectors. Light can never be sent properly out without that. There is a plan they have now, which I look upon as a failure; when I say so, from the extravagant cost of the lenses, &c. &c., and the light produced. I allude to the present plan of cut glass lenses without reflectors to give an intense light by subdividing it.

698. Are you not aware that the description of lenses which you mention are with the view of collecting all the light that otherwise is lost by having a single reflector?—I am perfectly aware that that is the reason they assign, but I beg leave to differ from them. My reason arises from this, that by my plan of reflectors I send out against even a plain glass a greater body of light, and a greater flood of light will be obtained and sent forth by reflectors than without, both as to distance and volume, and I conceive the cutting up of the body of light is erroneous in practice.

699. What experiments have you made to prove that?—I fitted upon the Clyde, three years ago, two lights, but they are not by any means burners of great size; as to the size of the burner, it is a very small burner.

700. What is the size?—I should call it equal to three candles. They were put up for the purpose of protecting the Custom-house surveying cutter lying off the harbour. I suggested to them that there was not such a thing as a guiding light in the river, and now was the time to get it.

701. Have you compared that with any other existing light, so as to be able to distinguish it at a greater or less distance?—That simple light I have seen at three miles; I have observed it in going down the Clyde at night, when the other lights were not perceptible from the vessels alongside; and were larger burners on my new plan used, the light would be seen much farther off.

702. Have you put it into juxta-position with any other established lights, and can you state the result?—I have not had it in my power to put them in juxta-position with other lights, but I know the lights or burners of the various kinds now in use, because I am conversant with them as a manufacturer, and I know the power of the various kinds of burners; I know the light depends upon the arrangement of the reflectors and lenses.

703. Have you applied to the Trinity House in London?—I cannot say that I have, as I thought it was useless; but they were kind enough to shew me their lights, and I was rather surprised to find that the burners they are now using are those which we have been using the last twenty years, except one which they have lately got, which is a large single burner. It is a kind of concentric burner; but it is not what I should call properly a concentric burner, nor do I think it of the best construction for giving out the light, being too confined.

704. Do you mean the French burner?—I do not know whether it is French or English. I saw it at the Trinity House.

705. Have you applied to the Admiralty?—The Admiralty sent for me about three or four months ago, relative to these signal lights for "vessels in distress," and to "prevent collisions at sea," which have been approved of at all the ports in Scotland, by the various shipowners, captains, &c.; and they have sent an intimation, I believe, to the various members to support it, and have it carried through. I was sent for by the Admiralty and sent down to Portsmouth, where I was six weeks on board the Rattler, in making experiments, where I had an opportunity of trying it fairly both on shore and at sea.

706. Has there been any report?—There is a report sent up, and as far as the naval gentlemen concerned gave their opinion, they were well satisfied and candid, and mentioned distinctly the advantages of it; but the Report not having been placed before the Board, I believe that it is now under consideration of the Board, and I have been waiting here six or eight weeks to hear the result.

707. Do you consider that the reflector and burners which you propose are peculiarly applicable to piers and harbours?—Yes, this new one is expressly made for that purpose, so that one uniform pier and harbour light may be used all over the world.

708. At what number of miles can it be seen?—As a tidal light it is not necessary that it should be seen beyond two miles, but it may be seen four or five miles off.

709. What is the nature of the present tidal lights?—They are upon no uniform plan; some are small, some large, some bright red, some dark red, some green; while in other cases there is total darkness for six hours while the tide is down. They also depend entirely upon the carefulness or carelessness of servants whether they are attended to or not. This simple light that I have brought forward, I propose to be uniformly red and green, and permanent; until the tide rises, the green colour denoting the depth of water, gradually appears; and as the tide recedes again, it falls, leaving the permanent red light in its place, showing with the utmost regularity the depth of the water in the harbour, so that a captain coming before the port sees at once the state of the tide in the harbour, whether it will allow him to enter with safety.

710. The light which you would subsitute for those in use is a self-regulated tidal light, rising and falling with the tide, which would enable captains of vessels off the port to know the exact depth of water at night over the bar?—Yes.

711. Has this been applied anywhere?—No, it has not yet been applied anywhere at all, and I now submit it to the Tidal Harbour Commissioners that they may have it tried wherever they may appoint.

[*The Witness withdrew.*]

Mr. *Richard West* and Mr. *William Allen* examined.

Mr. *West* and Mr. *Allen*.

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Mr. *West*.

712. (*Chairman*, to Mr. *West*.) What is your occupation?—I am a waterman, and have been employed for 10 years to pilot the ships of the General Steam Navigation Company.

713. What is the draught of water of such ships?—Generally about 13 feet water.

714. In the course of piloting those vessels, what impediments do you find to the navigation from London Bridge downwards?—We find very little water in the Upper Pool; we cannot move those ships after half-ebb, nor till half or two hours flood.

715. Then after you pass the Pool, do you find any impediment?—We find, after we pass the Pool, Limehouse Shoal very bad; we have only 5 or 6 feet water there.

716. At what time of the tide can you pass that shoal?—At half flood.

717. (*Captain Washington*.) But they have been dredging away that shoal, have they not?—Yes.

718. What depth have they made?—They have perhaps made 18 inches more water than there used to be.

719. Not more than that?—No, I think not.

720. (*Chairman*.) Will you state the extent of detention caused one day with another, summer and winter, from that shallow water?—We do not come up to London with Scotch steamers, only to Blackwall; but the large ships that come to London have to stop till the water flows.

721. If you had 12 or 13 feet of water in the river at low water all the way from London Bridge down, would that afford facilities to the navigation?—Yes; if we had 12 or 13 feet of water, we could get up and down at all times.

722. The steam-boats sail at all times of the tide?—Yes.

723. Consequently the detention now is very considerable?—Yes; at times we have to stop, but it is not often that those vessels come up just at the low-water time of tide.

724. Are we to understand that after half-ebb every day you are obliged to wait?—Yes, till half-flood.

725. In winter, in dark nights, is not that a serious impediment?—Yes, but we manage it; we always go in the dark.

726. (*Captain Washington*.) Do you do so with the Hamburgh steamers?—No, I go in the Scotch; Mr. Allen goes in the Hamburgh steamers.

Mr. *Allen*.

727. (To Mr. *Allen*.) Do the Hamburgh vessels carry the mails?—Yes.

728. At what time do they go?—We always start according to the time-table; the time-table is fixed according to the tide at 12, or 2, or 4, and sometimes 6: it is very rarely so late as 6; it is generally from 12 up to 2, or 4.

729. What time do you receive the mails on board?—About 10 minutes after 12, or at 12 at night.

730. (*Chairman*). Do you always start immediately you get the mails aboard?—No, according to time-table.

731. How long are you detained after receiving the mail?—Sometimes three hours, sometimes four, and sometimes two; sometimes not half an hour.

732. Is time lost by the vessels coming up with the mails?—No, because we can get to Blackwall generally with the mails; I have not, within my knowledge, been detained with the mails in coming up; we have generally found water up to Blackwall.

733. If you find water up, why cannot you find water down?—The difficulty is in coming to London through Limehouse Reach.

734. (*Captain Washington*). Where do you start from?—Horsleydown Wharf, which is abreast of the lower part of the Tower Wharf; we put the mail out at Blackwall as we come up.

735. What is your draught of water when loaded?—13½ feet.

736. (*Chairman*). Why do they not embark the mails at Blackwall as well as disembark them there?—I do not know.

737. Would it not sometimes save four or five hours?—It would just at low-water time; I have never been stopped in coming up with the mails unless there was a strong westerly wind sending the water down.

738. What water is there over Barking Shelf?—I should think, 13 or 14 feet in the Channel.

739. What is the average depth of water after leaving London Bridge in passing through Limehouse Reach?—Mr. *West*. After we get into Limehouse Reach, we have 12 or 13 feet.

Mr. *West*.

740. In leaving Horsleydown, what is the depth of water you find at low water?—We find about 8 feet at Harleydown at low water.

741. And consequently you are unable on that account to pass down?—Yes.

742. (*Captain Beaufort*). Do you know what the depth of water is over the Thames Tunnel at low water?—About 8 feet, I should say, over the top of the Tunnel.

743. You mean from the mud that lies over it?—Yes.

744. Do you know what depth of mud there is over the Tunnel?—No.

745. Have you been over it?—I have been aground upon it.

746. Do you think you were sticking on the Tunnel, or on the mud?—On the mud. I dare say Mr. Allen has been aground upon it also.

Mr. *Allen*.

(Mr. *Allen*.) We have frequently touched, during a low ebb, on the mud.

747. You never felt that you were grazing the top of the tunnel?—No, I do think we touched the brick-work.

748. (*Chairman*.) What do you think has been the effect of the dredging between Limehouse and lower down?—By the mark of the water on the vessel, I can tell to within four inches

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Mr. *Allen*.

before the removal of the shelf, I have come through and barely touched, and when I have got to the upper part, off the Canal Factory, we have touched the ground; there was a patch there just below the point. I think, on the general average, they might have made 18 inches more water there. You might find a hole where you might get three or four feet of water, but I consider that, on the general average, there might be 18 inches more.

749. That is a benefit?—It is a benfit, because, if I can get over that, I can get down to Gravesend.

750. (*Captain Washington.*) To what width have they dredged the channel through the Whiting?—I do not know. I have been obliged to keep between the hulk and the engines in order to get the best of the water.

751. Do you know whether they have widened it 100 feet?—I think they have made it 100 feet wide.

752. Ships could not turn in the channel?—Generally when they come up they could turn; there is plenty of water for them then.

Mr. *West*. 753. (*Chairman, to* Mr. *West.*) Near Greenwich, are there any impediments to the navigation?—Yes, there is a very bad shoal called Saunder's Shelf, off Cole's Child's Wharf.

754. What is the average depth of the channel there at low water?—It is about 10 feet; at low water at the best of times, and the narrowest part of the river.

755. At the West India Docks, what is the nature of the shoal?—It is a very bad place indeed; it is hard, and the top of it is dry at low water. Our Scotch ships lie two of them exactly between the shore and the shoal; at very low ebbs, you can stand on the top of it.

756. What is the depth of water there?—I should think, where our vessels lie, it is between 17 and 18 feet.

757. How far is it off the shore on the north side?—Perhaps about a couple of hundred feet; we can lay two ships inside it.

758. Is there anything that you know of to prevent their removing that rocky shoal?—Nothing that I know of, except that it is very hard. I am in the habit of going there with our Scotch ships every time.

759. Have you known ships to sustain any damage there?—Yes, I have been on it several times; I have touched it with the copper. I have touched it all round.

760. Have you grounded on any other part of the river?—No, if I can get from inside the shoal, I can always go down. I always go with the Scotch ships at 10 o'clock at night, let the tide be what it may.

761. Have you been with vessels where damage has been received from touching that shoal?—Yes, several times with those Scotch ships.

762. Do you make no complaints to anybody?—No, further than to the Company; if we suffer any damage, we make a complaint.

763. In Bugsby's Hole, what is the nature of the impediment?—It is very bad off there; there is a shoal on both sides.

764. Is it hard?—Yes, on one side.

765. What is the depth at low water?—About 9 or 10 feet. There are rocks, called the Blackwall Rocks, off the river Lea.

Mr. *Allen*. (Mr. *Allen*.) We consider that it is a kind of cement that runs away from the rust of the moorings; it is the same as iron rust and gravel mixed, it is three feet thick; and underneath you can scoop it out with buckets.

Mr. *West*. 766. In Woolwich Reach, do you find any difficulty?—Mr. *West*. Yes, we have very little water to the southward.

767. What is the width of the channel?—A couple of hundred feet, but it is always full of colliers; it is a collier section; they lie in the deep water.

Mr. *Allen*. 768. Does not that very much impede your navigation?—Mr. *Allen*. Yes, they lay their anchors so far out abreast of Gibson's Hole that we are liable to damage our vessels by running against their anchors.

769. Have you ever known ships damaged by that?—Yes, there was a Yorkshire brig sunk about 18 months ago by another vessel's anchor on that ground; she was lifted again, but there is no knowing how far they lay their anchors out, because sometimes they have 40 or 50 fathoms of cable. I make a practice of going as close to them as I can get.

770. Could not those colliers be removed by the harbour master?—They might, as they lie just in the deep water, and sometimes they lie two or three alongside of each other, and they lay their anchors out as far as they can; not half a boat's length from the main, there are 15 or 16 feet depth of water.

771. (*Captain Washington.*) Then, in fact, the best of the navigable channel is occupied by the collier section?—Yes.

772. And the navigation up and down is thereby very much impeded?—Yes.

773. (*Chairman.*) Off Galleon's Point, is there any obstacle to the navigation?—It is very flat there.

774. What is the depth of water?—There might be nine or ten feet over it below Bull's Point, which is opposite the Arsenal.

775. Is there not a good channel south of Galleon's Point?—Yes, the Government have two buoys that they move the convict ships to, and then just below that, extending for three parts of a mile downwards, there is a collier section that also takes up the deep water, and we are forced to keep over as near as we can to the shoal ground and go down the west shore.

776. That is an inconvenience, of course.—It is.

777. Below that, do you find any impediment before you come to Barking Shoal?—Yes, there is a nasty hill just off the upper part of Margaret's Ness. I have seen the Admiralty yacht, the Firebrand, aground there.

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778. At what time?—At the last quarter-ebb, but there was no fault attached to the commander of the yacht, because the colliers were lying then in the west section, and the vessel could not get into the channel, it being occupied by the colliers.

779. Are we to understand that berthing the colliers in the deep water in the different places you have alluded to greatly impedes and renders the navigation dangerous?—Yes, they drive other vessels right away from the deep water, and they must go over the shoal water; to get on with their passage, they risk it.

780. If those colliers were removed, you would have deep water in many places where you have not now?—Yes. Those colliers draw 15 and 17 feet water, and they lie in the channel, keeping afloat. If they do not remove those colliers, they ought to remove the shoal outside of them.

781. (*Captain Beaufort.*) Where do you propose to put those colliers?—There is one very good place for a collier section. They might lay then in tiers from the City Canal to the Folly House.

782. How many do you think that would take?—I should think they could stow from ninety to one hundred sail of vessels there.

783. Without interfering with the channel?—Yes. There they would be out of the way of the vessels coming into the Upper Pool.

784. How could they get rid of them in the lower Reaches at Greenwich?—There are none allowed at Greenwich. The upper section is Bugsby's Hole. If they were to lie in tiers above, they would make the channel more navigable. They could also make sections in the lower part of Harvey Reach, and nearly down to Dagenham. There is good water there.

785. (*Chairman.*) If that were done the channel would be left free for vessels?—Yes.

786. And the risk of grounding and doing damage to vessels would be less?—Yes.

787. Is there any other impediment before you come to Barking Shelf?—Yes, there is a nasty spit off Barking Shelf, which rises half across the river.

788. What water is there at that spit?—On that spit there is about seven, eight, and nine feet of water.

789. Have you known vessels ground there?—Yes; vessels coming up with little wind cannot yet across.

790. Have you known much damage done to vessels there?—I have known is do damage to the reels and strain the vessels in strong spring tides.

791. Does that frequently happen?—When the get upon the ground it happens with most of them, but they try to avoid it as possible; but when there is little wind, they cannot get over the top of it.

792. At what time of the year do you find that happen most?—In the fall of the year; in the short days, when there is little light, and a man wants to get to London soon; he does not see so clearly as he does in the long days, and he runs against that.

793. If those shoals were removed the navigation would be much better?—Yes, that cross ridge in particular wants lowering, and that would make the tide run down.

794. (*Captain Beaufort.*) What is the least water on Barking Shelf?—Seven, eight, or nine feet.

795. What is the best water you have in the channel there?—About 12½ and 13 feet. I come up with the steamers with 12½ feet of water.

796. (*Chairman.*) If that was removed, would not the current be directed?—Yes, it would down the north channel, and it would keep the north channel much more clear.

797. It would act directly against the Barking Shoal?—Yes, it is there that the Grampus, 50-gun ship, was lost; there was not so good a channel there formerly. In my time, the Indiamen used to come up to the southward, and now they always come up that way.

798. What has produced that change?—Getting the remains of the old Grampus up. Jones and Company got the Grampus up.

799. (*Captain Washington.*) When was the Grampus lost?—I recollect seeing her timbers at the time of the Mutiny at the Nore.

800. It was a 50-gun ship belonging to the Government?—Yes, it was on what they call Barking Shelf.

801. (*Chairman.*) Do we understand from you that Her Majesty's ship, the Grampus, grounded on that Shelf and became a wreck?—Yes.

802. And you recollect seeing her timbers?—Yes, I recollect the timbers of that ship there.

803. If the shoals were removed, what depth of water would be sufficient for the navigation of such ships as you take up and down?—Twelve or thirteen feet on the average at low water, because it would be but a very few minutes before the rise of the flood was two feet.

804. That would give you 15 feet of water in half an hour's flow?—Yes.

805. And that would answer the purpose?—Yes.

806. (*Captain Beaufort.*) What is the length of time of the low-water slack?—It depends upon the spring and neap tides; sometimes it will be half an hour before you see it come up.

807. What is generally the time of the slack?—Ten minutes; it is hardly 10 minutes after you can discern the tide leaving off ebbing before you can see it flow.

808. (*Chairman.*) Then are we to understand that 13 feet of water at low water would answer the purpose generally?—Yes, I think it would, and be a great improvement.

809. Have you attended at all to the embankment on the Thames, and considered what effect that would have upon the navigation?—Not at all with reference to the navigation of the Thames; but in my opinion, if they do not come too far into the Thames, I do not consider the embankment of the Thames would make any difference in the water. I think it would make more water, because the more clean the tide from the shore, the faster it would run.

810. Any means which would straiten the flow would increase the scour?—If the water

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had a cleaner run across the shore, the more velocity it had the more likely it would be to increase the flow.

811. (*Captain Beaufort*.) There was a part of a shoal removed some seven or eight years ago, just off Charlton, above the Dockyard at Woolwich?—Yes, it has made a great deal of difference to us. The Government did that at their own expense; there was a ridge that ran off from Charlton, and the Government wanted the water to run past the Dockyard to deepen the water there, and cut a small portion of the point off. They had an opinion that the water would carry the mud from the front of the Dockyard, and give them more water, and that is the reason why they had it removed, as I have been given to understand.

812. Whenever any shoal has been cut down in the river, have you found a tendency to grow up again?—No; this Charlton shoal is a proof of it. There is more water there now than there used to be by a good deal, but there is a middle hill outside.

813. (*Chairman*.) If that middle-hill was removed as the other has been, the channel would be very greatly improved?—Yes, and then I think the Government yard might receive the current more to the southward and along their wall.

814. And consequently it would move away the mud?—Yes.

815. (*Captain Washington*.) You say that you come up the river at all times of the tide?—Yes.

816. Are there any lights to guide you up and down above the Nore Light?—There is a light at Gravesend.

817. None between that and the Nore?—No.

818. Is there a want of lights in the river?—A light at Holy Haven would be of great service, either at Shell Haven or Holy Haven, because it would be a good leading mark for vessels to keep clear of the Bligh Sand.

819. Is there any other part of the river where lights would be useful?—Yes, at Broadness Point, opposite Grays; the tide flows all over that for above a mile.

820. Would a light be of use there?—At that time of the tide it would be of great service. There have been no less, to my knowledge, than four vessels dug out there within the last six weeks.

821. (*Chairman*.) Do you mean to say that four vessels have gone ashore there within the the last few weeks?—Yes, within the last two or three months.

822. What is the soil?—All hard blue clay; it is right on the marsh-land. In fact, to prove what I say, there is ballast there that has been taken out of the vessels. There was a vessel last week on it, and they have been obliged to dig her out.

823. You mean to say that the navigation there is dangerous?—It is dangerous at certain times.

824. (*Captain Beaufort*.) Where would you have the light?—At or near the beacon.

Mr. *West*. (Mr. *West*.) There is a beacon, but is of no use at night.

Mr. *Allen*. 825. At high water is it a regular sheet of water?—(Mr. *Allen*.) Yes, for a mile inland.

826. (*Chairman*.) Is it on that spot that vessels have been lost?—Yes.

Mr. *West*. (Mr. *West*.) There have been two or three Scotch steamers on that point.

Mr. *Allen*. 827. Has no complaint of that been made to anybody?—(Mr. *Allen*.) The steamers that navigate up and down have no means of getting redress without complaining to their employers. The masters of the Trinity House have placed a beacon there and abreast of Greenhithe; those are the only two beacons on the river.

828. At night they are of no use?—No.

829. The steamers coming up at night find the want very much of lights?—There is only one light which is of great assistance to us, and that is the Grays Light; it is a red light, and sometimes it is in and sometimes it is out. It is private property.

830. (*Captain Washington*.) Is it supposed to be lighted all night?—It is supposed to be lighted all night, but that rests with the man who is on board the barge.

831. (*Captain Beaufort*.) Who pays for that light?—The Pier Company.

832. (*Chairman*.) Is it your opinion that those places should be lighted with public lights on which the pilots could depend?—Certainly; that one in particular.

Mr. *West*. (Mr. *West*.) You must be below Greenhithe before you can see it; it is a dull light.

833. (*Captain Beaufort*.) Can you see it for a mile?—Yes.

Mr. *Allen*. 834. (*Chairman*.) Have you at any time seen vessels ground on the Ness?—(Mr. *Allen*.) Yes; when they have been working up they have gone in; they could not see the land; and I have known several vessels ground on it.

835. The beacon they could not see?—No.

836. Then you are indebted for the navigation at that part near Gravesend to a private light belonging to the Pier Company?—Yes, it is a very great assistance to us.

837. And that is uncertain, because it is not kept up at all times?—The light at the Gravesend Pier is kept up, because they keep men always there; but at the Grays Pier it is sometimes in and sometimes out.

838. Have you any other observation to make as to any impediments which you would like removed in order to clear the river?—Yes; there is a small shoal near the upper part of Erith Reach; I do not think there is above nine feet upon it at low water; there is a middle ground, and this is close in upon the south shore, just above the Sluice.

839. Is that sand or shingle?—It is sand, I think; but it is hard.

840. Have you known vessels ground there?—Yes, many.

841. Are we to understand that almost on every one of those shoals vessels ground?—Yes, at low-water time.

842. Have you known in the last year any losses of vessels from that cause?—Not losses,

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but sometimes a ship will ground there, and another will come and catch her and do 40*l*. worth of damage before the man can let go her anchor.

843. In addition, then, to the damage of vessels touching those shoals, you have the damage done from vessels running foul of them?—Yes.

844 Consequently the loss is very considerable?—Yes, suppose I am in a vessel just below, and I see another vessel catching the ground, I cannot let go my anchor because the vessels following me may get upon my vessel.

845. Are we to understand that almost weekly a vessel grounds on one or other of these shoals?—You can hardly go down any day without seeing vessels ashore upon them.

846. What would be the time saved if you had 12 feet of water in the river at low tide?—You could get under way directly, there would be no detention, as soon as the current came to assist you, if the wind were fair.

847. Now you have to wait some hours?—Yes, according to your distance down the river. If this is the shoal, and I am close to it, I have to wait two hours; but if I am down the river some distance, I have some way to go before I get up there.

848. In the winter, in dark nights, do we understand that these shoals very much impede the navigation, and often occasion the loss of one or two days?—Very often.

849. (*Captain Washington.*) Did not the French Government steamer, conveying the Duke and Duchess of Nemours, get aground on the Bligh Sand, and had she not to throw her guns overboard?—Yes, she threw her guns and coals overboard. If there were a light at Shellhaven, any man could run right from it till he saw it dip, and then he would shape his course to the Nore as straight as a line, till he brought the light to the starboard.

850. (*Captain Beaufort.*) Are you satisfied with the lighting below the Nore?—Yes, it is good enough.

[*The Witnesses withdrew.*]

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APPENDIX A.

REPORTS OF EXAMINING COMMISSIONERS.

No. 1.

THE RIVER THAMES AND PORT OF LONDON.

APPENDIX A.

PORT OF LONDON.

No. 1.

Report of the Examining Commissioner.

MY attention having been directed to the state of the River Thames, and its inadequacy of accommodation for the various branches of the trade of the Port of London, I propose to submit the result of my own observations and inquiries on that important subject, in addition to the inquiry conducted by this Board.

Rept. Select Committee of the House of Commons on the Port of London, 1836.

The state of the maritime approach to the metropolis affords a striking example of the injury, inconvenience, and needless detention to which the shipping and commerce, and public service of Her Majesty's kingdom are exposed, from the want of a central executive and controlling power for the preservation and improvement of its navigation.

Walker's Report to the Thames Navigation Committee. App. B. No. 276.

The public attention has been frequently drawn to this subject, and several inquiries have been instituted into the state of the river Thames before Select Committees of the House of Commons, and by other parties: and the results of their investigations, as well as those of this Commission, fully set forth the evils produced by the neglect of those whose duty it has been, as conservators of the river, to remove all impediments from its navigation.

Rept. of Metropolis Improvements, 1844.

Q 433.

Q 434.

It appears, that between the years 1830 and 1836, the river Thames was surveyed, by order of the Admiralty, by Captain Bullock, R.N., and a plan from London Bridge eastward has been prepared from that survey with great accuracy. He has pointed out in that plan the existence of eleven or twelve shoals in the river, between London Bridge and Erith, and, in his evidence before the Select Committee of the House of Commons in 1836, he describes them at length. As regards the Pool, he says, "The whole Pool is excavated into holes and hills. The Upper Pool is full of shoals; the Lower Pool is little better," and, generally, that the shoals are great impediments to the navigation of the river.

Ev. Q. 6.

In his examination before the Commission, he says, that these obstacles to the navigation of the river have not been removed; but that, on the contrary, in 1844, when he examined the river, he found that some of these shoals had increased.

App. B. Nos. 277-78-79.

App. B. No 281.

In 1841 he was also engaged with Mr. James Walker, C.E., and some of the city officers, to survey the river Thames, and their Report, already referred to, together with those of the two Harbour-Masters, the Clerk of the Works, and Water-Bailiff, furnish full details of the existing impediments, and point out the means of removing them; and the Report of the Thames Navigation Committee of the Corporation of London, dated 20th January, 1842, forwarding these Reports to the Lord Mayor and Common Council, approves generally of the same.

App. B. No. 276.

Mr. Walker, in his Report, states that, from a little below Erith up to London Bridge, there are fourteen shoals in the bed of the river, often extending half-way across the channel, with a depth of only six or seven feet on some parts of these shoals at low water. The bare list of these formidable impediments to the navigation of the Thames must command attention, and occasion serious reflections as to the causes that should so long have prevented their removal from so public a thoroughfare.

He says:—

"1. Ascending the river, the first bad shoal is below *Erith,* called *Rand's Hill,* a patch in the middle of the river, about 300 yards long by 100 yards wide, which has upon it, at ordinary low water, a depth of 8 feet.*
2. A little higher, *Cold Harbour,* a point of sand, extending from the north shore to near the middle of the river, also 8 feet.
3. A shoal of sand in the same reach (Erith), 200 yards above the last, and having a depth of only 6 feet.
4. *Dagenham Shelf* extends from the north shore, nearly half way across the river, with 8 feet.
5. *Barking Shoal,* one mile below Barking Creek, nearly in the middle of the river, has also 8 feet.
6. *Barking Shelf* commences opposite the creek, continuing nearly half a mile down, and extends across nearly two-thirds of the river, with from 6 to 10 feet only in the line of navigation. This is considered the worst shoal in the river. The *Trinity* lighters have for many years worked at the place, and have taken up an immense quantity of gravel; but the greater part of the clay and peaty surface, which is the worst part of it, remains.
7. A shoal, opposite *Galleon's Point,* extends from the north side, about one-third across the river, with 7 feet.

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* Very low tides ebb 3 feet lower, leaving, of course, 3 feet less water upon all the shoals than is stated above.

8. *Ham Shelf*, opposite *Woolwich* dockyard, extends from the north shore upwards of half way across the river, for a length of a quarter of a mile, exclusive of patches and projections higher up, and has upon a great part of it only 6 feet.
9. *Bugsby's Hole* is altogether a shoal-water reach, in places only 8 to 9 feet, with some shelves and small shoals having only 6 to 7 feet.
10. Immediately opposite to the river *Lea*, a shoal extends from the north side to the middle of the river, with only 8 feet.
11. A little above the entrance of the river *Lea*, is a dangerous small rock of concreted gravel in the middle of the river, with only 9 feet.
12. Two "*middle grounds*," in the centre of the river, between *Blackwall* and *Greenwich*, have upon them 9 to 10 feet.
13. App. B. No. 276. *Whiting Shoal*, a little above the *Commercial Dock* entrance, a dangerous shoal, in nearly the middle of the river, has in places only 7 feet.
14 *Limekiln Shore Dock*, from the north side, goes nearly two-thirds across the river, with only a depth of 5 feet."

See Plan, p. 38 *a*. It will be seen, by the plan of the river, that these shoals, and particularly the last-mentioned one, are very great obstructions to navigation at all times, and especially at very low spring tides.

Mr. Walker has now stated to this Commission that no measures have been adopted, that he is aware of, to carry out the general recommendations contained in his Report, although the Navigation Committee reported to the Lord Mayor, in 1842, that "they have attentively considered the several propositions which these Reports contain, and they are forcibly struck with the importance of giving effect to many of their recommendations."

Captain Fisher, Principal Harbour-Master, however, has informed this Commission, that the Whiting Shoal, a little above the Commercial Dock, and nearly in the middle of the river, has been almost all removed in the course of the last year, and that there is now an increased depth of water at that place; but that none of the other numerous shoals have been removed.

App. B. No. 276. Mr. Walker, in his Report, points out the great irregularity of the shores of the river, even where embankments have been formed in modern times, for want of a general system or plan for their erection: he has pointed out the advantages which would arise from deepening the bed, and adopting a continuous, and, as nearly as possible, regular and uniform line of embankment along the whole course of the river.

He recommends that the depth in the mid-channel shall be twelve feet at low water throughout the whole extent from London Bridge to Gravesend; and he gave an estimate, in 1842, that all the shoals already enumerated might be removed for 60,000*l*., with an additional charge for cutting off the elbows and making the embankments shown in his plan; and that the whole of these improvements might be effected in a few years. He has now stated to us that he has reconsidered that estimate, and that in his opinion it may be acted upon with an additional charge only for the increase of wages now payable more than in 1842, when the estimate was made.

Captain Bullock, in his evidence before this Commission, concurs entirely in that opinion.

Ev. p. 22. Mr. Rowland, the Harbour-Master, who was also examined before the Commission, concurred generally with Mr. Walker in the Report of 1842; and he is now, after four years' additional experience, confirmed in all the opinions he then gave of the necessity of improving the shores of the river, and of removing its shoals. He also recommends that provision should be made for the removal of the seven sections of laden colliers, which are berthed in the App. B. No. 280. deepest parts of the river, and which greatly interfere with the navigation. The City of London has, by its regulations, fixed the number of laden colliers allowed to occupy these seven sections, at four hundred. Mr. Rowland strongly urges the erection of docks to receive those colliers, and thus free the river from this serious impediment, in which I entirely concur, and regret that former recommendations to that import have not been attended to. I would Ev. p. 18. especially refer to the evidence of Mr. Knight, Branch Pilot, before this Commission, as to the extent of the existing impediments to the navigation from these shoals; and it appears from his statement that Her Majesty, in her voyage from Scotland, in 1844, was detained more than two hours to admit of water for the royal yacht up to Woolwich.

Ev. p. 29. The evidence before this Commission of Messrs. West and Allen, Pilots to the General Steam Navigation Company for the last ten years, is very important, as their daily experience during that time has given them ample opportunity of ascertaining some of the various evils occasioned by the present state of the river. They state, among other instances, that the dispatch of the mails to the Continent is often delayed for hours for want of water over the Q. 731. shoals near Blackwall.

Mr. Rowland, Mr. Knight, Mr. Allen, and Mr. West, all concur in the fact of very serious impediments to the shipping arising out of the existence of these shoals. They state that scarcely a day passes without vessels grounding in some part of the river, causing loss and delay, with great inconvenience, and sometimes total wreck; and they know of no reasons against the immediate removal of all these shoals. Mr. Rowland also repeated his opinion of 1842, that lights might be very advantageously placed in some parts of the river.

Q. 511. Mr. Allen's evidence, as to the beneficial and lasting effects of removing part of a shoal from the vicinity of Woolwich, would strongly encourage the removal of the other shoals, as the increased depth which was obtained by that removal has been preserved with great advantage to that part of the river. The shoal was removed by order of the Admiralty and at the public expense.

APPENDIX A.

PORT OF LONDON.

No. 1.

Report of the Examining Commissioner.

These pilots state that in winter the few hours of daylight are frequently lost to vessels going up to the Pool or docks, by the impossibility of passing these shoals until near half-flood, thereby often occasioning a delay of tides, or even days, and a consequent great additional expense and risk of injury to the shipping.

The great increase of navigation by steamers, which depart and arrive at all times of the tide, renders the deepening of the river, and the widening of the navigable water-way, of more importance than ever to the commerce of the port of London; and these circumstances point out the immediate necessity of not permitting any longer delay in the execution of these most important works.

The competition of railroads with shipping, for the conveyance of goods to and from the metropolis, has become altogether a new, and, at the same time, a strong additional reason for improving the navigation of the Thames, and for lessening its expense by every practicable means; and I therefore specially call attention to the present state of this competition, and to the probable decrease of the shipping, and of the commerce of the port of London, unless the charges of freight by sea can be reduced to meet the low charges of railroads, and removing the shoals will have that desired effect.

The observations of Mr. Page, civil engineer, on the river Thames and the port of London, deserve particular attention, as he has of late years been much occupied in their examination. He recommends that the shoals should be removed by dredging, so as to form a channel of 600 feet in width, having a depth of 14 feet at low water, and gradually sloping up towards the shore on both sides: and he states that this improvement is daily becoming more necessary, from the fact of the tides having ebbed considerably lower since the removal of old London Bridge, so as to leave the river above that part barely navigable at low water for small steamers not drawing more than 4 feet water. Mr. Page differs from Mr. Walker: as he thinks that the broad parts of the river should not be narrowed by piling, but should be deepened to allow of tiers of colliers and other vessels being moored near the shore, out of the stream, and thus clear the navigation, which is now so much interrupted by the tiers of colliers berthed in the deepest parts of the river. He also points out that, whilst colliers remain in the stream, the coal-barges, receiving from them their loads, also occupy at times the whole width of the channel; and he agrees with Mr. Walker that the natural irregularities in the depth of the water have been greatly increased, and the ebb and flow of the tide consequently impeded, by the injurious practice carried on by the Trinity House of dredging only for gravel fit for ballast. App. B. No. 283.

The Commission have, in their First Report, recommended "that a Board of Conservancy should be established for the superintendence and protection of all the tidal harbours and navigable rivers in the United Kingdom of Great Britain and Ireland; that it be in connexion with the Admiralty, and that it be permanent;" and I submit, that the history of the proceedings respecting the removal of the impediments in the river Thames, affords a strong illustration of the necessity of that recommendation. 1st Rep. p. ix.

It appears, by the evidence of the respective solicitors, that a suit was begun in 1844, between the Commissioners of Her Majesty's Woods and Forests and the Corporation of the city of London, as to their several jurisdictions and powers. Ev. p. 10.

The Woods and Forests claim that the right to the freehold in the soil of the river Thames, and the shores thereof, should be established in the Crown, whilst the Lord Mayor claims the same right for the city of London, as Conservator of the Thames.

The suit will, in all probability, be prolonged for five years, and, perhaps, for a longer period; and, whilst it accounts, in some degree, for the delay that has taken place in carrying into execution some of the several recommendations for the improvement of the river, I submit that legislative measures should forthwith be adopted to appoint a Commission immediately to carry out the improvements of London river, irrespective of the pending suit.

I have had communication with the Lord Mayor, as Conservator of the Thames, and also at the same time with the Committee of Navigation, and I am assured of their anxious desire now to make arrangements for that purpose; and I have no reason to doubt the willingness of the Commissioners of Woods and Forests to do the same.

It appears absolutely necessary, therefore, that powers should be given to the Conservancy Board, if such shall be established; or that a separate Commission should be appointed, having all the powers essential, not only to prevent the further deterioration, but also to remove all shoals and other impediments to navigation, and to take such steps as shall be considered necessary for the improvement of this noble river.

I do not enter into the question whether, as stated by the solicitor to the Woods and Forests, all the moneys received from the meteages and other dues by the Lord Mayor, as Conservator, are applicable to the improvements of the river, as I leave that to the decision of the constituted law authorities; but I feel confident that, as such a hearty desire is now expressed by all parties to carry out all practicable improvements in the river, that ample funds will be found to meet the expenses which must necessarily be incurred.

It, however, appears, that 3600*l.* have been applied by the city of London, within the last two years, specially to the removal of the Whiting shoal and other improvements of the river, and that that amount is to be charged on moneys receivable from a rental fund arising from licences given to embank different parts of the river; but as an injunction, pending the existing suit, has been obtained to stay the grant by the City of any further licences, that fund cannot be increased. Q. 204.

See Grants to Trinity House, 13 Eliz. 36; 17 Charles II.

1st Rep. Q. 2503.

It becomes my duty to call attention to the evidence before the Committees on Lighthouses, and on Metropolitan Improvements, and to that given before this Commission, respecting the manner in which the Trinity House have exercised the powers intrusted to them under their grants for ballastage, and for the "cleansing of the river Thames from shelves and other annoyances."

It appears that they raise the ballast which they supply to the shipping in the port of London, not from the shelves and banks, which form the shallowest parts of the river, but only from the places where they find the best shingle ballast, leaving the loamy mud and peat, and other substances of which the shoals consist, to impede the navigation, and thereby they make by dredging the bed of the river a series of "hills and deep holes," which, of course, is quite incompatible with the uniform depth which is universally considered so essential to its future improvement and navigation. The evidence of pilot Allen on this subject is very important.

The Board of Trade, on the 26th of May, 1834, applied to the Trinity Corporation to know why they did not remove the shoals or banks in the river; and the answer, dated the 30th, assigns, as we consider, no satisfactory reason for their refusing to do so.

See Grants of the 36 of Elizabeth and of 17 c. of Charles II.

See App. No 30, Rep. Port of London, 1836.

See Lighthouse Report of 1844, App. No. 5. N

The Corporation of the Trinity House also derive a profit from the privilege of supplying ballast to the shipping in the river Thames, which they expend in charity. In the year 1832, the amount of revenue from ballast was 32,161*l.*, and the expense 28,820*l.*, leaving a profit of 3,340*l.* that year; and it is believed that, under a different system, the profits might be greatly increased.

I submit, therefore, that, as the grants of ballastage appear to have been made to the Trinity Corporation for the purpose, in the first instance, "of cleansing the river from shelves and other annoyances," the manner in which they have hitherto exercised the powers intrusted to them should be fully inquired into and ascertained, with the view of applying all the proceeds to their legitimate object.

I may also state that there are other sources from whence ample funds might be drawn for the improvement of the river, but these will come more immediately under the consideration of Her Majesty's Government when they shall have all the facts before them.

In strong confirmation of the unanimous opinion of this Commission of the necessity of appointing a separate and responsible body for the improvement of the river Thames, I submit the following Resolution of the Select Committee reported to the House of Commons in 1836:—

See Report, par. 3, on the Port of London.

"That this Committee are of opinion that the various conflicting jurisdictions and claims of the Admiralty, the Trinity House, and the Corporation of the City of London, over the river Thames below the bridges, have had a most injurious effect upon the interests of navigation; that it is desirable they should be consolidated and vested in some one responsible body, and that means should be found to provide for the removal of shoals and obstructions in the bed of the river."

I am further strengthened in the opinion I have given by the perusal of the evidence taken before that Select Committee, and by the evidence of every witness examined by this Commission as to the present state of the river, as well as by the fact that ten years have been allowed to pass without any attention having been paid to the chief recommendation of that Committee: and, therefore, as the result of all my inquiries, I again strongly recommend that immediate legislative measures be adopted for placing the conservancy of the river Thames under a separate authority, acting under the Board of Admiralty, or the separate Board of Conservancy of all Tidal Waters (if such shall be established), with full powers to adopt the best plans for its improvement, and to remove as speedily as possible, and as far as shall be practicable, all shoals, jetties, and other impediments to its navigation; and that these improvements shall be proceeded with irrespective of the suit now pending between the city of London and Her Majesty's Woods and Forests.

JOSEPH HUME.

APPENDIX A.

DUBLIN.

No. 2.

No. 2.

PORT AND HARBOUR OF DUBLIN.

Report of the Examining Commissioner.

THE ownership of the soil and bed of the river Liffey and Port of Dublin is claimed by the Corporation of Dublin, under the Charters of the City, granted by the 2nd John and 13th Henry III., and in virtue of this claim, they levy about 1,800*l.* a year upon shipping, under the heads of Slippage, Anchorage, Chapter and guild, lord mayor's and water-bailiff's fees.

7 Nov., 2 John; 14 Jan., 13 Henry III.; 24 Eliz.; 13 Car. II. 6 Ann, c. 20. 3 Geo. III., c. 15.

In 1707, the river having become extremely shallow and nearly choked up, the conservancy of the port, by an Act of the Irish Parliament, was vested in the Corporation of Dublin, with power to erect a Ballast Office, and to levy dues upon tonnage, &c., to be applied in amending and cleansing the river and port. In 1763 they were empowered to license fifty pilots. By thirteen successive grants of the Irish Parliament, between the years 1753 and 1780, the Corporation received 57,169*l.*, to enable them to build and complete the south or Ballast Office wall, with a proviso that they should account, every three years, to the Lord Lieutenant and Council; this condition, it appears, was not complied with.

24 Geo. III., c. 1. § 33.

26 Geo. III. c. 19.

In 1786 all former Acts relative to the port were repealed, as having been found ineffectual, and a new Board created, by the style of "The Corporation for preserving and improving the Port of Dublin," which, under the more homely title of "The Ballast Board," has since managed the affairs of the port.

This Board consists of twenty-two members, of whom the Lord Mayor of the city, the Sheriff, and three Aldermen, who represent the Corporation, form a part. With the exception of these five *ex officio* members, the Board is self-elected, but subject to the approval of the Lord Lieutenant and Privy Council; once elected, they are members for life, provided they are not absent from the meetings of the Board, without leave, for three months. Their services are entirely gratuitous.

26 Geo. III. c. 32; 27 Geo. III. c. 25; 30 Geo. III. c. 25; 32 Geo. III. c. 35; 33 Geo. III. c. 54; 34 Geo. III. c. 8; 40 Geo. III c. 47; 40 Geo. III. c. 73: 43 Geo. III. c. 127; 51 Geo. III. c. 66; 6 & 7 W. IV. c 117; 1 & 2 Vic. c. 36.

The Act of 1786, and the following Acts named in the margin, granted powers to the Board to levy dues, to borrow money, to license pilots, to heave ballast, &c., and also defined the extent of the harbour jurisdiction, namely, from Barrack Bridge to Sutton Creek, on the north, and to Dalkey on the south, including the quays, walls, bridges, &c.

Besides the dues and the above-mentioned grants, made by the Irish Parliament to the Corporation of Dublin, it appears that the latter had borrowed large sums of money for the purpose of building the Ballast Office or Quay walls, whereof a certain amount was due for principal and interest; this became a debt chargeable upon the funds for improving the harbour and river. Since that time additional sums have been borrowed, and although the Board received from Government in 1814 the sum of 100,183*l.*, as purchase-money of the Pigeon-House basin and premises, the whole of which has been expended, the debt has increased, and now amounts to 99,300*l.*, for the interest of which the annual income is subject to a charge of 4,114*l.*

The total income of the port is about 33,000*l.* a year; but the available portion of this appears to be 15,000*l.* from tonnage dues, about 2,000*l.* from surplus of ballastage, and 3,000*l.* from quay-wall rates, in all about 20,000*l.* a-year.

Parl. Pa. Nos. 65 and 571 for 1845.

A fuller statement of income and expenditure, with the scale of dues, &c., will be found in the Parliamentary Returns, Nos. 65 and 571, for 1845. For various details connected with the accounts of the port, such as the issue of debentures, the disregard of restrictions on the power of borrowing, the departure from the directions of the Act with regard to the Sinking Fund, the arrears of rates on the North Lots, &c., reference must be made to the Appendix to the Report of the Municipal Corporations (Ireland), p. 184, *et seq.*, as being too complicated a subject to be entered upon in this brief inquiry.

App. B. Ev. p. 3.

The Harbour Board, as we have seen above, is composed of twenty-two members, five of whom are aldermen, &c., of the city corporation; for the remaining seventeen the Act of Parliament requires no qualification: it is not necessary that the individual selected to fill a vacancy should be a mercantile or nautical man, or represent the shipping interests, or in any way be connected with the city or its trade. It will not create surprise that this constitution of the Board, and the results of it, are viewed with considerable dissatisfaction by members of the mercantile body, and by the public generally. Lloyd's agent, after enumerating several causes of complaint in the harbour, says, in evidence, "Ask the merchants of the city if complaints to the Ballast Board are attended to?"

Hitherto we have treated of the Ballast Board with reference only to its duties, as having the conservancy of the harbour; but great as are its powers, and responsible as are its duties under this head, they are insignificant when compared with those of another branch of the public service of the most extensive and important description, namely, the management of all the lights, buoys, beacons, and landmarks along the coasts of Ireland, which have also been placed under its control. Such a charge would, it might be supposed, require in the Board to which it is entrusted, a certain amount of nautical skill and judgment, in order to determine on the best description of lights, to select their most appropriate position, and to decide upon their right elevation; together with an intimate acquaintance with all sand-banks, rocks, and shoals around the coast, so that lights, buoys, and beacons, may be placed to the best advantage. It will be manifest, by the constitution of the Board, in what manner Parliament has provided for these requirements; and it will appear in the course of this inquiry, what cause an Admiralty surveyor, who has been twenty years employed in the examination of the Irish coast, has for stating in his public report, "that the lights and buoys of this coast, admirably as the former may be managed in detail, are lamentably defective both in number and position."

It will be seen by the annexed plan that Dublin Harbour is formed by the channel of the Liffey, which has been quayed on both sides through the city. On the south side of the channel a wall three miles in length has been extended from Ringsend, in an easterly direction, across the South Bull Sand, to the Poolbeg lighthouse at its extremity. Half-way along this wall is the Pigeon House Fort, with a small tidal basin, erected about the year 1798. On App. B. No. 55. the north side, the bold measure has been adopted of carrying out a rough, rubble, stone half-tide mole or pier, called the Great North Wall, extending 1½ miles from the Clontarf shore in a south-south-east direction across the Bull Sand, towards the Poolbeg lighthouse, leaving an entrance between of 1,000 feet in width.

From the imperfect documents transmitted to the Commission, it is not easy to trace the progress of the works for the improvement of Dublin Harbour. In 1707, as has been stated, in consequence of the bad state of the river, the conservancy of the port was vested in the Corporation of the city; in 1711, soundings were taken on the bar, which showed a depth of from App. B. No. 9. 5 to 7 feet at low water spring tides, or from 18 to 20 at high water. In 1711, at the recommendation of Mr. Corneille, an engineer, and Captain Burgh, Surveyor-General, the channel was improved between the city and Ringsend, and a frame-work of timber filled with stones was placed on the north side of the river. In 1713, Captain John Perry proposed to extend a dwarf wall of rough timber from Rings-end to the eastern spit of the South Bull, a distance of 3 miles, which was begun and carried on in the following years. He also proposed to run a bank across from Rings-end to the north shore, with a sluice-gate in it, and thus convert the river into a floating dock! Happily for the port of Dublin, this suggestion was not approved of. In 1725, a survey of the river was made, and Captains Perry and Burgh reported on the state of the works, and sent in a plan made by Mr. Gabriel Stokes: later in the same year Perry published his proposal for making a harbour at Sutton Creek, just within the promontory of the Howth, and communicating with the city by a canal; this plan was reported against by the Ballast Board. Apparently the South Bull wall was completed about the year 1735, as a floating light was then placed at its eastern end. In 1761 a rubble-stone wall was begun as a substitute for the timber work, and the Poolbeg lighthouse was built at its extremity.

The first chart of Dublin Bay, we believe, is that of Greenvile Collins, in 1685, published in his "Coasting Pilot;" it shows few soundings, but marks 6 feet on the bar. The next is that of Mackenzie, in 1762; this is also a mere outline, and very meagre in details; the depths shown on it are:—In the east channel of the bar, 8 feet; in the Poolbeg anchorage, 12 feet; App. B. No. 5. and from the Pigeon House to the quay, only 2 feet. In the year 1800, Sir Thomas Hyde Page reported on the harbour, and among other things recommended converting a portion of the bar, at the mouth of the river, into an island. It is quite possible that this might have proved a beneficial measure, and by creating additional scour, have caused a channel to open out to the eastward, so that the ebb tide from the river would have harmonized with the nine hours set to the north-east, which sweeps round Dublin bay.

About this time we first meet with the project of the Clontarf wall, which appears to have originated with the Ballast Board (it is believed at the suggestion of Mr. Crosthwaite), and in App. B. No. 8. a very able letter stating its probable advantages it was recommended by that Board to the Directors-General of Inland Navigation, who had then charge of all great public works. Feeling the want of a more detailed survey of the river and bar before coming to any decision on so important a proposal, Captain W. Bligh, R.N., was now employed to sound the harbour, and in App. B. No. 6. January, 1801, he made his Report, giving detailed directions for entering the harbour, and a plan for its improvement. On his chart the depths marked are:—On the east bar, 5 feet; in the south bar channel, 8 feet; on the ford, 4 feet; and from the Pigeon House to the city quays, 2 feet; being much the same as those shown by Mackenzie in 1751. Bligh's plan for improving the river was to extend a pier in an easterly direction from the end of the present north wall, along the southern edge of the North Bull Sand, starting with a width of channel of about 700 feet, and gradually widening till it should reach the spit of the sand opposite Poolbeg, leaving a width between of 2000 feet. The object of this wall was to cut off all the drift sand from the Clontarf shore, and by confining the stream of tide and the freshes of the river, to turn them to useful account in scouring the channel. He also recommended a systematic and vigorous course of dredging to be set on foot at once; he says "the most essential duty towards the shipping and commerce is immediately to employ a sufficient number of men to level the bed of the river; there should be at least 50 lighters, and 350 men employed on this service."

Had Bligh's suggestions in 1801 been acted upon at once, Dublin Harbour would probably have been in a better state a quarter of a century ago than it is now.

In July, 1802, Mr. Rennie was called on to report generally on the harbour and Dublin bay. App. B. No. 9. After reciting many of the above plans (with the exception of the last), he sums up by recommending,—1st. That a wall should be extended from the north shore, near Clontarf, towards the Poolbeg lighthouse, leaving an entrance between of 550 yards in width; 2nd. To embank the South Bull, making a reservoir of 1300 acres, to be filled and emptied by the tide through an opening at Rings-end; 3rd. To run out jetties at right angles to the Clontarf shore to the edge of the sand, and thus to define the channel; and, if required, to extend the south wall, and that proposed at Clontarf for 600 yards towards the bar.

It does not appear, nor is it easy to understand, why this proposal thus supported was not acted upon at the time; the pressing necessity for something being done was made manifest to

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NOTE.—Andrew Yarranton's plan for a harbour at Ringsend, proposed in Nov. 1674, we have not seen.—*Yarranton*, p. 151.

all by the wreck or damage within the bay or harbour of not less than 124 vessels in the six years from 1797 to 1803. After a lapse of 17 years, the Clontarf wall was adopted, and it has proved even more beneficial to the bar than had been anticipated :—the reservoir on the South Bull yet remains to be made.

In 1818, a survey was made by Mr. Giles with great care and detail, and his plan is a highly valuable document, as forming a standard with which to compare all following surveys. From his plan it appears that on the east bar channel there were only six and a half feet of water; in the Poolbeg anchorage from 12 to 15 feet; at the Ford, in the deepest part, only seven feet; and from the Pigeon House to the city quay from two to four feet at low water springs; the range of tide being 13 feet. Such, then, appear to have been the results up to the year 1818, of the expenditure of about a quarter of a million of money on Dublin Harbour.

App. B. No. 11.

In May, 1819, Messrs. Giles and Halpin made a joint report relative to the site and the direction of the great north wall, which, being favourably received, this work was immediately set on foot, and vigorously carried on for the five following years, during which time a sum of 103,055*l*. was expended on it. In 1822, Messrs. Telford and Whidby were consulted, and both reported favourably on the progress of the work.

The propriety of this measure, which involved so heavy an expenditure, has been a subject much controverted amongst persons connected with the port; but it is believed that there is now but one opinion as to its beneficial effects, and that the plan evinced both good judgment and skill.

App. B. No. 12.

In 1833, an effort was made to establish a ship canal from the Asylum Harbour then completed at Kingstown to the city, and the subject was favourably reported on by a select Committee of the House of Commons. This project was very properly resisted by the Ballast Board, and Mr. Halpin's report on the subject fairly sets forth the grounds of refusal. It had, however, the good effect of stimulating the dredging operations in the river, which Mr. Bourne's memorial states had been much neglected, and enumerates various cases of damage to vessels which had occurred in consequence.

App. B. No. 13.

In 1838, the Admiralty ordered a detailed survey of the bar and harbour, which was carried out by Captain Frazer, R.N., and his assistants; the result of this was a strictly impartial record of the state of the bar and channel, which thus afforded the means of testing the value of the works carried on since Giles's survey of 1818. The comparison proved highly satisfactory; the depth over the bar has been increased to 10 feet at low water, or 23 feet at high-water springs; the passage is in a direct line with the entrance; the channel of the Liffey has been straitened and deepened by dredging, and large steamers, and sailing vessels of 900 tons, have gone up at high water and discharged their cargoes at Dublin quays.

These are great and creditable improvements, and the consequence has been a large increase in the number of arrivals, amounting, in 1845, to 4769 vessels, of 653,680 tons burthen, and a corresponding increase in the tonnage of the port.

App B. No. 15.

A project has been recently brought forward by the Secretary, the acting engineer to the Grand Canal Company, and favourably reported on by Sir John Macneill, to restore the stream of the Dodder to its natural course, and cause it to discharge itself on the South Bull Sand, to the southward of the South Wall, and thus entirely to free the harbour from one of the great causes of deposits of silt. In connexion with this is the proposal for making a large tidal basin at the entrance of the docks, which would be a very valuable addition to the resources of the port; and, lastly, it is proposed to revive the plan suggested by Mr. Rennie in 1802, of raising a dam on the South Bull in order to form a reservoir for the tidal water to be admitted by an opening from 200 to 300 feet wide in the South Wall, near Rings-end, and thus obtain a large amount of additional scour on the ebb: these three proposals are well deserving of very mature consideration, and in the mean time an immediate stop should be put to any further extension of the enclosure made at the back of the South Wall in order to receive the soil dredged up in the channel of the river.

The other harbour works undertaken by the Ballast Board consist in the rebuilding of a great part of the quay walls; in the construction of a patent slip; in placing several screw moorings; and in adding 530 yards of timber frontage to the North Quay; the latter rendered necessary by the very shallow foundation of the quay walls, which will not admit of dredging sufficiently for large steamers to lie alongside them.

The commerce of the Port of Dublin had increased so much towards the close of the last century, and the inconvenience and damage from vessels always lying on the ground at low water were so great, that Parliament granted 45,000*l*. for constructing wet docks. The Grand Canal Docks, on the south side, of 25 acres in extent, were opened in 1796. These docks afford 2000 yards of quayage, and have from 17 to 18 feet depth of water; they are entered by the Camden and Buckingham locks; the former having a width of 35 feet; and its entrance sill having 7½ feet over it at low water, and from 19 to 20 feet at high-water spring tides. Within the docks, on the eastern side, are 3 graving docks, the width of their gates being respectively 35, 25, and 22 feet; but these are far from sufficient for the increased size and number of the ships trading to the port.

App. B. Ev. p. 3.
App. B. No. 14.

It was stated in evidence, and it is also asserted in a written document furnished to Parliament, that the entrance sill of these docks is several feet above the bed of the river; now, so far from that being the case, it is manifest, from soundings and sections recently made under the direction of Sir John Macneill, that the "chamber of the Camden lock is as low as the deepest portion of the centre of the river opposite, and lower than the bed of the river at

App. B. No. 15.

several points upwards." It is true, that a high sand-bank exists, or did exist, just outside, which nearly blocked up the channel to the docks, but this is not the fault of the Canal Company who, it is stated, have repeatedly complained to the Ballast Board of this obstruction.

Seeing the inconvenient lying of ships at the south quay, and knowing generally the great desire of ship-owners to keep their vessels afloat in wet docks, it is difficult to understand why the Grand Canal Docks are not more extensively used; it is not owing to excessive dues as the charges both for floating and graving dockage are represented as reasonable, we can only attribute it then to the obstruction at the entrance arising from the river Dodder there discharging itself into the Liffey; whereby, especially in time of floods, a large quantity of silt is deposited. Now, the Irish Parliament, by the Act of 1786, provided for and enjoined the turning of the course of the Dodder, so that it should discharge into the bay on the strand of the south Bull; and, it is stated, that it was on the faith of this being done, that the present entrance to the Grand Canal Docks was selected; the Ballast Board, however, has hitherto neglected to carry out the intentions of the Legislature in this respect, doubtless to the loss of the Grand Canal Company, and certainly to the great detriment of the harbour.

26 Geo. III. c. 19.

The Old Dock, and St. George's, or the Custom House Dock, are of 8 acres area; the latter was opened in 1821. These docks offer 1200 yards of quayage, have 16 feet depth of water, and 35 feet width of entrance; the lower sill is about 15 inches higher than that of the Grand Canal entrance, or has about 6 feet over it at low water.

App. B. No. 14.

The work of dredging the harbour has latterly been carried on by two steam-dredgers, one of 20, and the other of 25 horse-power, which can raise from 700 to 900 tons of soil daily. They cost 12,000*l.* The first was employed in 1832 (or 10 years later than similar vessels had been in use on the Clyde), and the second in 1837; there are also 50 mud-boats.

There is one patent graving slip, completed in 1833, at a cost of 15,232*l.*; it is found to be of much benefit, but like the graving docks, is not sufficient for the trade; and large steamers have recently been compelled to seek at Holyhead the accommodation that their own port does not afford them.

The inland communication by water from Dublin consists in the Grand and Royal Canals, both connecting with the Shannon.

The Grand Canal, begun in 1765, leaves Dublin on the south, and proceeding westward by Sallins, Robertstown, and Tullamore, joins the Shannon at Shannon Harbour. The length of the main trunk from the Liffey to the Shannon is 80 miles, and thence to Ballinasloe, on the borders of Galway, 16 miles, being 96 miles in a western direction; the length of its six branches 68 miles, total length 164. The summit level near Robertstown, about 26 miles from Dublin, is 279 feet above the sea level. Total traffic in 1844 to and from Dublin, 239,014 tons; tolls, 32,014*l.*; inwards, 24,525*l.*; outwards, 7,489*l.*; passengers, 99,528; fares, 21,571*l.*

The Royal Canal, begun in 1789, proceeds from the north side of Dublin, westward by Maynooth, and Mullingar to Tarmonbarry on the Shannon, with a branch from Killashee to Longford, its total length being 92 miles. The summit level near Mullingar, about 53 miles from Dublin, is 322 feet above the sea; it is fed from Lough Owel in Westmeath. Its total traffic in 1844, was 91,066 tons; tolls, 13,353*l.*

The NUMBER and TONNAGE of VESSELS belonging to the Port, and of Arrivals and Sailings in 1845.

	Belonging to the Port.				Coastways.				British Colonies and Foreign.			
	Under 50 Tons.		50 Tons and upwards.		Inwards.		Outwards.		Inwards.		Outwards.	
	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.
Sailing Vessels	269	7,671	115	20,976	4,349	340,146	1,737	115,202	305	69,204	210	48,821
Steamers . .	3	133	32	8,532	1,018	246,094	1,025	247,837	3	648	Sailed coastways	
Total . .	272	7,804	147	29,508	5,367	586,240	2,762	363,039	308	69,852	210 ..	48,821

Population of Dublin, 232,726 in 1841; number of seamen, 11,661 (registered 3314); of fishermen, 947 men and 87 boys; of coasters, 4773; total seafaring population 17,468.

The river Liffey rises near Blessington in Wicklow, about 10 miles S.S.W. of Dublin, and at a height of 1715 feet above the sea; after flowing 47 miles in a circuitous direction, and receiving in its course several small tributaries, it falls into the sea in the bight of Dublin Bay. The extent of country drained by the Liffey, that is the area of its rain or catchment basin, including the Dodder and Tolka, is about 568 square miles.

Assuming that the average annual fall of rain in Ireland amounts to 36 inches, and that two-thirds of this quantity are evaporated, the Liffey bears every year 586 million cubic yards of water to the sea. At times the freshes come down in great strength, but owing to the nature of the bed of the river, or to the want of sufficient guidance, it is said that they have little scouring effect on it. The river is navigable at high water, by barges, as high as Island bridge weir, about 2½ miles above the city, and this spot is the limit of the tide, which, it is stated, would run a mile higher if the weir were removed.

The whole area of the harbour at high-water spring tides within the piers is 3030 acres, or nearly four square nautic miles, and at low water 744 acres, or one-fourth of the former; the amount of water admitted on every tide is about 49 million cubic yards.

APPENDIX A.

DUBLIN.

No. 2.

Report of the Examining Commissioner.

App. B. No. 4.

The pilot establishment of the Port of Dublin consists of 53 persons, of whom 36 are sea pilots, 8 apprentices, and 9 river pilots. The sea pilots are not only inadequately paid, but not paid according to distance; and, as might be expected, they will not go far to sea to pick up vessels, but usually wait for them till they come into Dublin Bay. The pilot-master, an intelligent officer of the Royal Navy, is quite aware of the evils of the system, but no efficient steps have been taken by the Ballast Board to remedy them. It simply requires a short Act of Parliament to amend the present schedule of rates, or, which would be better, the pilots might be relieved from the tax on their earnings to support the pilot boats. The distinction of river and sea pilots, the former earning double the money and not doing half the hard work of the latter, is unjust and prejudicial.

In justice to the Ballast Board, in their capacity of a Lighthouse Board, it is right to state that they have recently made a reduction of 10 per cent. on all their light dues. Of the policy of such a measure, considering the want of lights, buoys, and beacons around the coast, to which it will shortly become our duty to advert, we need express no opinion; but when we remember that the lights of Ireland are already economically managed, and that, as it appears, each burner costs less by nearly one-third than a similar light in England, we feel bound to state that this reduction is a very great boon, not only to the trade of Ireland but to all vessels that navigate the Irish Sea.

Par. Rep. on Lighthouses, No. 607, for 1845.

The chief grounds of complaint stated against the management of the port are:—That the mercantile body and shipping interest are not represented at the Ballast Board, and that their complaints are not attended to; that several of the chief members of the Ballast Board are also members of the Chamber of Commerce, whereby the latter has lost its influence as an independent body; and that practically, the management of the port (as well as of the Lights) is confined to one or two members of the Board. That the proceedings are conducted in private; and that the accounts are not published in the local newspapers, so that those who pay the dues know nothing of the manner in which they are expended.

44 Geo. III. c. 47.

App. B. Ev. p. 3.

Complaints also are made that the foundations of the quays on both sides of the river have been so imperfectly laid that the river will not bear deepening any more until they are rebuilt; that the foot of the quays on the south side of the river, the resort of three-fourths of the shipping of the port, is encumbered with mud; that the harbour-entrance to the Grand Canal Docks is obstructed by a sand-bank; and that the river Dodder is permitted to make large deposits in the harbour, instead of being turned out over the South Bull, as enjoined by the Act of 1786. That the ballast supplied to shipping is of so bad a quality as to have been complained of in 1843 by upwards of 70 shipmasters, and again in 1845 was nearly the cause of the loss of the *Eagle* and of the *Swift* of Weymouth; and that it is compulsory on ships to take the ballast provided for them, for which, by Act of Parliament, the Ballast Board charges 1*s*. 11*d*. a-ton, or double the price at which it might be obtained.

App. B. No. 13 *a*.

App. B. Ev. p. 3.

Shipowners and merchants also complain that there is a great want of graving docks, so that vessels belonging to Dublin are obliged to go elsewhere to be repaired; that the port charges are very high, and disproportioned to the advantages received; that there is a want of mooring-posts along the quays, and that no trouble is taken to moor vessels properly, especially at the south quay; that there is but one public crane, and yet a merchant could not get permission to put up a private one; nor is there any shed to protect merchandize from wet.

It has been further represented that a conspicuous beacon is wanted at the extremity of the Clontarf Wall; that the fog bell at the Poolbeg Lighthouse might be improved; that the buoys in the river are very small; that the pilots' charges on steamers carrying cargo are particularly onerous, and their services useless; that the sea pilots are very ill paid, and are never found at any distance off shore; that the dues levied by the corporation of the city on shipping amount to 1800*l*. per annum, not a shilling of which is laid out on the harbour; and that while the gross revenue of the port is 33,000*l*. a-year, a debt has been contracted of nearly 100,000*l*.

App. B. Ev. p. 5.

App. B. No. 3.

App. B. No. 2.

JOHN WASHINGTON.

Appendix A.

Wexford.

No. 3.
Report of the Examining Commissioner.

No. 3.

PORT OF WEXFORD.

Wexford harbour, formed by an extensive slake or estuary of the river Slaney, is situate at the south-eastern extremity of Ireland, and immediately at the entrance of the Irish Channel. From its position in a rich country, watered by a deep navigable river, amidst an industrious population, and close to the track of the vast number of shipping that annually pass through St. George's Channel, Wexford is admirably placed for commercial purposes; whilst from its proximity to England, being only 48 miles from the nearest point at St. David's Head, it seems to be marked out as the connecting link for direct steam communication between the metropolis and the south of Ireland, and the extreme western limit of the British islands at Bantry Bay and Valencia.

In its present state, however, these advantages of position are of little avail, as a bar having only 11 feet depth over it at high tides, limits the traffic of the port to coasting vessels of a small draft of water.

The form of Wexford estuary is oblong, having its greatest length about eight miles north and south, or parallel to the coast, its greatest breadth from Wexford bridge to the harbour's mouth, nearly four miles; and its average width little more than two miles; it has a total area, including the tideway above the bridge, of 22 square miles, with an entrance less than half a mile wide, and through which this large basin of 14,000 acres has to be filled and emptied every tide; the consequence is, that the force of the current has torn up the bed of the channel at its entrance to a depth of 50 feet, and deposited the soil just outside where it forms a bar, having only eight feet water over it at low water; it has the additional evil of a very small rise of tide, namely, five feet on springs, and three feet on neaps.

34 Geo. III. c. 26. The dangerous and unsafe state of this bar led to the Act of 1794, which, after reciting that this evil might be remedied by confining the water of the estuary and deepening one or more channels, and that the trade would be benefited by erecting quays and making proper floating and graving docks, appointed a body corporate, consisting of 50 persons, for carrying into execution the purposes of the Act by the title of "The Corporation for Improving the Bar, Town, and Harbour of Wexford." This Act imposed certain rates and duties on all vessels coming to the port, and empowered the Corporation to charge for ballast, to appoint pilots, and to borrow money not exceeding 6000*l*. But as these rates and duties were only to continue in force for 53 Geo III. c. 158. 31 years, an Act was passed in 1813, "For the further Improvement of the Harbour of Wexford," which extended the term for 31 years more, and increased the charges for ballast; it expressly provided also, that the said rates and duties should be applied towards maintaining and improving the harbour, and to the payment of salaries of officers, "so far as relates to the 6 & 7 Vict. c. 41. said harbour, and to no other use or purposes whatsoever." In 1843, the term having expired, another Act was obtained, which extends the provisions of the Act of Geo. III., which is still the governing Act, but it alters the number and qualification of the Commissioners; under the present Act, all in the possession of a house valued at 21*l*. a-year are eligible, and, of course, the number is unlimited;—the actual number of Commissioners is 104.

It will be seen that the preamble to the Act of 1794 recited that the navigation might be improved by confining the water of the estuary and deepening the channel; it may be useful to relate briefly the various proposals for carrying this measure into effect.

It seems that Nimmo's coast survey did not include Wexford, as no mention of it is made in his reports. The first chart of the harbour is that of Mackenzie in 1762; this shows few details, but it marks 7 feet over the east bar; the next is said to have been made by Fanning, a master in the navy, about 1799. A map, by Gill, about 1811, is the next on record. It is said that as far back as 1808, and for some years after, there were from 12 to 14 feet over the East Bar at low App. B. No. 284. water spring tides; this is affirmed by Powell, by many old pilots, and by Mr. De Rinzy, who also states that, in 1820, a part of the Dogger Bank formed an island, covered with high grass, on which he had often landed. About 1830, Powell, who, from his long residence, had gained great knowledge of the port, proposed to guide the stream through the deep water channel of the Gull, and to make a new outlet to the harbour at Windy Sheard, about one mile to the south-west of the present outlet. A little later, Willis proposed a plan something App. B. No. 35. similar. In 1831, Sir John Rennie recommended, 1st, That the different channels within the entrance should be collected together and guided so as to act in the same direction; and, in order to prolong their effect as far as the bar, that the present Hantoon Channel should be closed. 2nd, That the channel from the entrance to the town should be dredged, and that no diminution of the tidal water should on any account be permitted. In 1833, Mr. Barry Gibbons suggested making a canal, with tide-gates, through the mudlands by Rathdowney, having its outlet in the deep water in the bight of the South Bay, and leaving the river to App. B. No. 36. take its present course. In 1837, Mr. M'Call proposed to cut a channel through the south mud banks, across the Burrow of Rosslare into the South Bay, about three miles south-west of the present entrance, and to reclaim 9000 acres of the mudlands. In 1838, App. B. No. 37. Mr. Cubitt was requested to report on Mr. M'Call's proposal, of which he did not approve; but recommended instead that the river, after passing Wexford quay, should be trained into the deep water of the Coal Channel, and that the present shallow channel between Raven Point and Mussel Point be dammed across, thereby forcing all the water to ebb and flow in the same direction; and this he supposed would keep up a direct channel over the bar; App. B. No. 38. the probable cost of this plan would be 100,000*l*. In November of the same year, Mr. Jack reported upon the harbour. He disapproved of all former proposals, except Mr. M'Call's, in favour of which he expressed a decided opinion.

Report of the Examining Commissioner.

App. B., No. 39.

Two years later, in 1840, Captain Vetch, R. E., was employed to report on the advantage of reclaiming certain mudlands in the counties of Wexford and Waterford, including those of Wexford Harbour. Taking advantage of the admirable Townland Survey of Ireland (for which every one employed on similar investigations must feel grateful at every step), he was enabled to state accurately the surface of the estuary at high water to be 14,270 acres; at low-water spring tides, 3649 acres; leaving uncovered at low water, 10,621 acres; and of this last quantity, he was of opinion that about one-half, or 5000 acres, might be reclaimed with every prospect of advantage; but that the remainder lies too low for effectual and economical drainage. Captain Vetch, however, is not content with thus stating his opinion, but proceeds to investigate the whole question of the improvement of the navigation, and lays down several correct principles for the guidance of those who undertake similar works; in fact, this Report, although in the first instance drawn up for the purpose of showing what mudlands might be embanked, is in reality the very best treatise on the improvement of Wexford Harbour, that had been published up to that period. The embankments proposed would contain about 2000 acres on the north, and 3000 on the south; but Captain Vetch adds the useful caution not to proceed with the second till the effect of the first on the harbour should have been fully ascertained.

In 1841, Sir John Macneill proposed making a ship canal 200 feet in width, with tide-gates, from Ferry Bank just below the bridge, through Beg Erin Channel, to the deep water in the North Bay, or from the lower part of the town to the South Bay, the entrance in either case to be sheltered by a detached breakwater placed in four fathoms' water.

See Plan, p. 102.

Hitherto there had been no accurate nautical survey of this harbour, and all proposals for its improvement were in a great measure legislating in the dark; but in 1841, the Admiralty directed a detailed survey of the harbour and its approaches, which was carried out with great care by Captain Frazer, R.N., and his assistants, and completed in 1843. In this chart, the exact rise of tide, and the rate and direction of the stream, both within the harbour and in the offing, are carefully marked, and the extraordinary hole of 50 feet depth, scooped out by the tidal current, at the entrance of the harbour, is first clearly shown. It is further valuable as a standard by which to compare the results that may arise from any attempts at improvement, for it cannot be imagined that Wexford Harbour will long be permitted to remain in its present neglected state.

App. B. No. 42.

In the year following, Captain Frazer offered some suggestions arising out of his survey of the harbour, and first proposed that the Hantoon Channel should be deepened, and the Dogger Bank be raised above water. He concludes from his observations that any works thrown out with a view to scour a more direct channel would prove unavailing, as they would only remove the bar a little further out; and even if successful in making a clear passage, no vessel would venture to approach it in an easterly gale opposed to a north-easterly or flood tide. In proof, although there is deeper water over the North Bar, vessels frequent the Hantoon or South Channel, on account of its position being sheltered by the Dogger Bank from the east. Besides, the North Bar is of fine shifting sand, the South or Hantoon of hard gravel, and he is of opinion that the latter, if once dredged to a depth of 12 feet at low-water springs, would maintain itself open.

App. B. No. 41.

In 1844, Mr. Rendel was required by the Admiralty to report on certain plans for embanking the mudlands. He gave his opinion that a large tract of them might be reclaimed with advantage to the harbour, provided the embankments for that purpose were properly designed and executed. But that more information as to the tidal currents was required before he could express an opinion as to the proposed outlet for the harbour into South Bay; yet, at the same time, he reported that the importance of Wexford Harbour is such as to make it expedient to encourage any well-considered plan for its improvement.

App. B. No. 43.

The subject of Wexford Harbour having been brought before the Tidal Harbours Commission by Mr. Wark (who submitted a novel plan for its improvement), Mr. Airy, offered some observations on the measures best adapted to that end. After referring to the sources of his information, and especially to the Admiralty Chart, by Captain Frazer, Mr. Airy notices, 1st, the remarkable circumstance of the relation of the extent of the harbour to its width of entrance, showing that the discharge is the same as if a river of half a mile in width, and 50 miles in length, were to be filled and emptied at every tide, and that probably in no harbour in the world is the "equivalent channel" so long. And, 2ndly, the relation of the depths at and near to the entrance. where the water suddenly deepens from 9 feet to 50 feet, and a little farther out shoals to 9 feet again; this latter condition is shown to be the natural result of the enormous tidal scour, which, being confined in width, has scoured for itself a proportionate depth, and deposited the soil thus disturbed on the bar without. The first step in improvement then, Mr. Airy is of opinion, must be the contraction of the tidal surface of the great basin. With reference to the next step, the direction of the stream, it is shown that Mr. M'Call's plan, would leave the town of Wexford on the convex side of the channel, and its quays would consequently soon be blocked up with mud. All circumstances considered, Mr. Airy is disposed to approve of carrying the channel, from the point at which it leads to the south-east towards the present outlet, directly to the deep water in the North Bay.

App. B. No. 44.

Mr. Wark suggests starting from the Point of Park, about a mile above Wexford Bridge, and continuing the channel through the mud lands direct to sea; and by placing a dam across the channel at Gull Bar to convert that part of the river opposite Wexford into a floating basin. Also to close the present outlet, and to reclaim all the mud lands in the North Bay.

App. B. No. 45.

The most recent proposal, and the fourteenth for the improvement of the harbour, is by Mr. Farrell, who has the advantage of having been a resident for five years at Wexford, as County Surveyor, and thus professionally called upon to pay much attention to the state of the river and harbour. His Report, plans, and tidal observations, are far more elaborate than any of the preceding; he investigates the condition of the river from Enniscorthy to without the bar, rightly judging that it is to the upper part of a river we should look for a tidal reservoir, and not near its outlet; also that easy water communication with the interior of the country should form a part of any comprehensive plan for improvement. The Report is accompanied by very instructive transverse sections of the river and estuary from Ferry Carrig Bridge to the Dogger Bank, without the harbour's mouth; the section of the entrance showing the sudden dip to 50 feet, is one of the most remarkable on record.

Besides the enormous mass of tidal water to be discharged through a narrow outlet, Mr. Farrell points out that the total area of the catchment or rain basin of the Slaney, being 880 square miles, would in times of flood deliver 340 million cubic feet of water, or 1-6th part of the whole discharge, in addition, during the six hours of an ebb tide; the velocity of which, rushing through a narrow outlet, would be sufficient to tear up the bottom of any river, unless it were of rock.

Having stated the disease of the harbour, he prescribes as remedies:—To deepen the river Slaney, regulate its width, and widen the pass of Ferry Carrig Bridge; to remove the present bridge and causeways at Wexford; to contract the high-water area of the estuary, so as to guide the ebb and flood in the same direction; to dredge this basin to a uniform depth of 11 feet at low-water springs; to widen the mouth of the harbour to three-quarters of a mile; to raise the Dogger Bank into a permanent island; and to dredge the Hantoon Channel. With respect to the entrance, Mr. Farrell mentions three plans;—either to lead a channel into the North Bay; or into the South Bay; (in both cases closing up the present entrance;) or, to preserve the present outlet, and by deepening the Hantoon Channel, and raising the Dogger Bank above water to obtain a deep and sheltered approach:—and this last he thinks the best.

With reference to improvements in Wexford, there seems no doubt but that the superficial extent of the harbour exceeds the maximum of utility, and ought to be diminished; that its form is of the worst description, and would be improved by cutting off portions from the north and south wings of the inlet; that every facility should be given to direct the tides along the river channel, past the quays of Wexford, and up the course of the Slaney towards Enniscorthy; that not one yard of tide land should be embanked near to or above Wexford Bridge; that the ship dock, the ballast wharf, and the solid causeways of the bridge are highly prejudicial to the useful action of the tide, and that they ought to be removed; and that with these alterations it is probable the tide would rise as high or higher at Carrick Bridge than at the entrance of the harbour; and if the same process of dredging and confining the channel were carried upwards, it is not improbable that a similar rise of tide might be obtained at Enniscorthy, and thus good water communication would be rendered available into the heart of a fertile and populous county.

In the course of the examination at Wexford, the opinions of sea-faring men and others on the question of a harbour at Ballygeary Bay or Carne, were elicited; those residing near Carne and in St. Margaret's Bay, naturally advocated the claims of those places, and the Admiralty surveyor, as far as he had examined the coast, without expressing any opinion on the subject, pointed out the advantages they possessed in a bold coast; in their freedom from a great part of the shoals that render the approach to Wexford difficult, and in the gain of three feet rise of tide; at the same time, he admitted, that for the trade of Wexford alone, the South Bay would be the most convenient place for a harbour.

App. B., No. 55. From the evidence of the pilots, and from the official Report to the Admiralty of Captain Frazer, R. N., who has surveyed this part of the coast, it appears that there are but seven buoys and beacons to mark the several extensive shoals which line the east coast of Ireland between Dublin and the Tuskar, a distance of 70 miles; that eleven additional buoys are required, and especially a floating light is wanted on the Blackwater Bank, a notoriously dangerous shoal in the vicinity of Wexford, and on which 43 vessels have been wrecked within the last few years, and a lamentable loss of life has occurred.

App. B., No. 55. The Coningbeg Light Vessel is represented to be inefficient; she occupies a very important station, and yet in blowing weather, at the time it is most needed, her lights are said to be almost useless on account of her rolling so heavily, either from the lanterns being too weighty, or from the ill-suited form of the vessel; to quote the expressive words of the master of a steamer between Bristol and Waterford, "we often cannot see her light till we are a-top of her." It has long been intended to place a lighthouse on iron piles on this half-tide rock (the Coningbeg), and for more than three years persons have gone off in the summer, under the pretence of working at it; but, up to this time, it appears that only a few holes are jumped in the rock. A similar instance of apathy or delay occurs at the Fundale Rock, off Carnsore, where two years have been spent in erecting a perch! Had these works been placed in the hands of an efficient contractor, both one and the other might long since have been accomplished.

Par. Report on Lighthouses, No. 607, for 1845. Now when we consider that by official returns 13,322 vessels, of about three million tons, annually pay dues to the Ballast Board of Dublin for the Coningbeg Light (not including ships in ballast, ships of war, revenue cruizers, fishing smacks, coasters under 20 tons burthen, vessels driven into port by stress of weather, and foreigners not bound to any port of the United Kingdom), we shall not err greatly if we assume the number of vessels of all classes that pass along this coast annually at 18,000. How important then does it become that these two lights, the Tuskar and the Coningbeg, which are the chief and indeed only lights for all the trade on this coast that passes in and out of the Irish Channel, and in the direct track of the mails between Milford or Bristol and Waterford, should be maintained in the most efficient state that could be devised. By the account of the late agent for Lloyd's, it appears that during the last thirty years 170 vessels have been wrecked on this coast; the value of property is estimated at more than a million of money, while the positive loss of life has been 270! App. B., No. 285.

The pilot establishment of Wexford consists of 16 pilots, 13 of whom are stationed at Rosslare Point at the entrance, and three are harbour pilots. They undergo no examination by the Harbour Commissioners before their appointment; but are selected and placed for six months under the Superintendent of pilots. They are paid by salary, and not by their earnings: and, as might be expected, are not over zealous in their duty. They have a pilot cutter to cruize without the banks for shipping, but seldom use it, and wait till vessels approach the harbour to board them in their boats.

APPENDIX A.

WEXFORD.

No. 3.

Report of the Examining Commissioner.

The total income of the port of Wexford is 2,400*l.* a-year, but the available portion of this is about 1,400*l.*, arising from tonnage dues; of this sum it appears that, on an average of the last ten years, less than 100*l.* a-year has been expended on improvements or repairs in the harbour. In 1843 the sum of 1,789*l.* (or considerably more than one year's available income) was expended in legal and parliamentary expenses; on another occasion, 1,700*l.* was spent in a suit at law in procuring water for the inhabitants. The Act authorises the Commissioners to borrow 6,000*l.*, but restricts them to that sum; the debt now amounts to 4,600*l.*

The NUMBER and TONNAGE of VESSELS belonging to the Port, and of Arrivals in 1845:—

—	Belonging to the Port.				Coastways.				British Colonies and Foreign.			
	Under 50 Tons.		50 Tons & upwards.		Inwards.		Outwards		Inwards.		Outwards.	
	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.
Sailing Vessels .	34	1,245	70	6,662	716	38,136	543	25,322	19	2,988	7	1,322
Steamers . . .	..	..	1	228	106	17,148	88	15,254	..	..	..	..
Total .	34	1,245	71	6,890	822	55,284	631	40,576	19	2,988	7	1,322

Gross produce of the customs, 9,500*l.* The exports are grain, provisions, cattle, and poultry. Population of Wexford, 11,252 in 1841; number of seamen and boys, 700. The Wexford fishery district comprises 68 miles of coast; has 323 registered fishing vessels, employing 1,400 men and 150 boys. The salmon fishery produces about 2,000*l.* a-year, but with proper exertion and protection it might be much more valuable.

The quays at Wexford are 1,000 yards long, and faced with granite; they were finished in 1827, and their cost, including bringing pipe-water into the town, was 15,000*l.* There are various projections into the river, both above and below the bridge; the most objectionable are those immediately above the bridge, and opposite Richmond House, (the owners of which, by the Act of 1807, are liable to a penalty for building within high-water mark without the consent of the Admiralty), and the Dockyard below. There is an enclosure, also, of about 800 acres, near the Gull Channel, made in 1816. But the worst evil is Wexford Bridge, rebuilt only about 1830. Besides its numerous narrow openings, more than half the whole length of the original bridge is filled in as a solid causeway; the effect of this contraction of the channel is to heap up the water, which caused so great an increase of velocity in the stream that the bridge was likely to be swept away; and in order to secure it, large stones have been thrown in from time to time, until an artificial bar some feet high has been raised; and to this the Harbour Commissioners, it appears, did not object. 47 Geo. III. c. 159.

A Bill has been brought into Parliament this Session for enabling a private company to improve the harbour by carrying out the chief works suggested by Mr. Farrell in his Report and Plans. As a general principle we should object to such powers being given to any but to the Harbour Commissioners; but as we have seen that, for the last 50 years, those who have had the power have taken no steps towards improvement, we cannot but rejoice that others have undertaken the task, having sufficient guarantee in the fact that the plans must be approved of by the Admiralty before they can be carried into execution. If worked out as a *bonâ fide* harbour improvement plan, not considering the reclamation of mud lands as the chief object, we confidently anticipate that it will lead to the most beneficial results.

The chief grounds of complaint at Wexford are:—That the number of 104 Harbour Commissioners is highly objectionable, as only a few of them attend except on particular occasions, when some specific object is to be attained; that although the Act expressly provides that the rates and duties should be applied towards maintaining and improving the harbour, and since the passing of the first Act the sum of 50,000*l.*, exclusive of pilot and ballast dues, has been so raised, yet, except in building the quays and placing a few buoys and perches, no money has been expended in such improvements; that the stream of the Slaney and the tidal waters of its vast estuary are left entirely uncontrolled, and no effort has been made to guide them in a right direction; that the pilots pass no regular examination; that they do not go outside the banks to look out for ships; that they are paid by salary instead of by their earnings, and that the whole establishment is inefficient. 53 Geo. III. c. 158.

That the timber frame-work at the foot of the quays projects several feet into the stream, thereby causing damage to vessels; that there is a want of mooring-rings on the quays, and of mooring-buoys in the river, to keep vessels off the quays; that there is no tide-scale in any part of the harbour; that a ballast-bank has been formed at a most objectionable spot, and must be removed directly improvements are begun; that a rock, which might be easily blasted away, is allowed to remain in the middle of the harbour; that the solid causeways and narrow arches of the bridge, with the artificial reef of rocks at its foot, are very prejudicial to the fair flow of the tide; that the buoys and beacons are insufficient, and what there are are so small they can scarcely be seen in blowing weather; and that, although wrecks are of common occurrence, there is no light on the most dangerous bank on this part of the coast. App. B. Ev. p. 46. App. B. Ev. p. 47.

JOHN WASHINGTON.

No. 4.

PORT OF WATERFORD.

The capacious natural harbour of Waterford is formed by the channel of the river Suir, from the city to its confluence with the Barrow, and thence by the joint estuary of these two rivers to the sea, which they reach by a common outlet 2½ miles in width, between Black Nob on the west, and the well known promontory of the Hook Head on the east.

The city of Waterford lies on the south-west bank of the river Suir, at 15 miles from the sea, and is accessible at all times, by vessels not exceeding 11 feet draft of water, and at tide time by ships of 800 tons quite up to the quays. On the shores of the estuary are the pier-harbours of Dunmore and Passage on the west, and of Duncannon, Arthurstown, and Ballyhack on the east.

The limits of the port of Waterford are from Bilberry Rock, half a mile above the city, to the Hook Tower. By the local Act of 1784, the water-bailiff of the city was empowered to regulate the discharge of ballast and the mooring of vessels; but as no special board had the management of the harbour, everything was neglected, and it is said that frauds to a great extent were practised on the masters of vessels trading to the port. 24 Geo. III. c. 52, 56, 60.

56 Geo III. c. 64. In 1816 an Act was obtained "for deepening, cleansing, and improving such parts of the river Suir, as constitute the port and harbour of Waterford, and for the appointment of a pilot-office and ballast-office in the said city." The Act appoints twenty-four Commissioners by name; seven of them are members of the corporation of Waterford, twelve are members of the Chamber of Commerce, and the remaining five are gentlemen of Clonmel; the Directors General of Inland Navigation in Ireland, for the time being, are also members of the Board. In the event of a vacancy, the respective divisions elect one from their own class to fill it. The Act directs, *inter alia*, that four of the Commissioners, chosen by the Chamber of Commerce, should go out every three years, but be eligible for re-election; and that the harbour accounts be published annually in one or more local newspapers.

The main object of this Act was to take measures for enlarging and deepening the channel north of Little Island at the Upper and Lower Fords, and thus, by avoiding the circuitous and rocky King's Channel, to obtain a direct passage to the town; this has since been accomplished at a cost of 24,388*l.*, of which sum Government granted about three-fifths. The width of the cut is 70 yards, and it has a depth of 7 feet at low, and 20 feet at high-water spring-tides.

See Plan, p. 102. The town-reach of the Suir extends about one mile in a south-easterly direction, with a breadth of from 200 to 350 yards, and has a depth varying from 15 to 60 feet at low, and 70 feet at high water; the whole of this extent on the south side is faced with limestone quays, which for a length of about 1200 yards between the bridge and the mall, are 40 yards wide, affording the finest range of quays in the United Kingdom. Convenient floating stages, rising and falling with the tide, are placed at intervals abreast the quays, at a short distance from them, communicating by means of gangways or bridges, and it is alongside these floating hulks or stages that the whole traffic of the port is carried on.

This mode of doing business, which at first originated in necessity, from the increase of the mud preventing vessels from approaching close to the quays, has gradually grown to such an extent, become so interwoven with the habits of the people engaged in the shipping business of the port, and been found to possess so many advantages over lying alongside a fixed stone quay, especially for steamers, that it is doubtful if the system would be laid aside, even if sufficient water at all times could be obtained close to the quays.

Near the western limit of the town a timber bridge, built in 1793, of 39 arches, crosses the river. It measures 277 yards in length, by 14 yards in breadth; the openings vary from 3 to 11 yards in width, and rise 12½ feet above the level of high water; the piles are 15 inches thick, and the whole occupy 20 yards of the water-way of the river; there is a drawbridge on the south side 10 yards wide, which is all the accommodation afforded for the traffic of the river upwards, to Carrick-on-Suir and Clonmel.

There are no documents, that we are aware of, by which to trace the progress of improvement in Waterford Harbour. Shortly after the Act was obtained, it appears from the harbour books that Mr. Killaly, C.E., was called upon to make a report and estimate for deepening the Ford Channel, which at that time had about two feet water in it. The whole of this work, to the extent above mentioned, appears not to have been completed till 1829. No further works seem to be on record, except building and repairing parts of the quays, and placing the hulks, till the steam-dredger began to work in 1843.

App. B. Ev. p. 89. The earliest plan of Waterford Harbour is said to have been made by Doilley in 1641; Greenvile Collins, who surveyed some of the harbours in Ireland 40 years later, gives no plan of Waterford in his Coasting Pilot; the first published chart is that of Mackenzie, in 1763; this gives few details, but shows 10 feet water over the bar; detached plans also of various parts of the harbour have been made at different times for special purposes by Nimmo, Price, Killaly, and others. The next survey is that by Messrs. Carter and St. Leger, C.E., published by the Harbour Commissioners in 1835, a reduced copy of which accompanies this Report; it shows 6 feet at the Upper Ford, 9 feet at the Lower, and 11 feet over the bar. The Ordnance or Townland Survey, on the scale of 6 inches to a mile, comes next, and gives the accurate outline of the land to low-water mark, but no soundings; on this latter is based the nautical See Plan, p. 102.

survey under direction of the Admiralty, now being carried out by Captain Frazer, R.N., and his assistants. The examination of the upper portion or town-reach of the river is already completed, and it clearly shows the banks which have formed in the middle of this part of the harbour, owing to the current not being properly guided.

Report of the Examining Commissioner.

One of the first objects that strike a stranger on examining the harbour of Waterford, is the beauty and extent of its quays; the next must be, if at low water, the enormous deposit of mud at their foot. In 1838, Mr. Cubitt was consulted on the best means of getting rid of this evil, and generally as to improving the harbour; and in his Report he states, that the cause of the deposit is the natural formation of the river, just above and just below the quays; that by placing a turnwater on the opposite side, the current of the river might be so directed as to keep them clear; that he would not recommend the extension of the quays, but strongly advises the use of a steam-dredging machine. He recommends also the deepening of the Ford Channel from 7 to 10 feet, and that the passage over the bar, in a line with the leading lights up to Duncannon be deepened to 18 feet at low water, and this he considers would render the navigable approach to the city of Waterford as complete as could reasonably be required. App. B. No. 53

Now considering that Waterford has had the advantage of a Government steam mail communication with Milford daily for the last ten years, and has been the head-quarters of the Government steamers employed on the Admiralty survey of the coast for two years past, it would seem to argue a great want of enterprize not to have at once made an effort to carry out Mr. Cubitt's recommendations with respect to cutting a channel through what that eminent engineer says "can hardly be termed a bar," and thus at once to have rescued an admirable natural harbour from the taunts that rival ports will be sure to cast in its teeth. The flat it would be necessary to cut through is only about 800 yards long, and a channel 100 yards wide would be ample; and the outlay of one or two years' available income in the hire of an efficient steam-dredge would soon have been repaid by the increased traffic that always follows in the wake of improvement in a port, besides the immense advantage of enabling more powerful mail-packets to be put on the line in order to keep up uninterrupted daily communication without ever having to wait for water. The passage from Milford in winter is boisterous, but it has been maintained with tolerable regularity, considering the inefficiency in size and power (owing to being limited in draft of water) of the vessels employed on it. The distance from quay to quay is 90 sea miles; under very favourable circumstances it has been accomplished in nine hours, five minutes; but against a heavy contrary gale of wind, 39 hours is said not to be an uncommon passage. To quote the report of a Select Committee of the House of Commons on Post Office communication, in June 1842, "the whole of this line, as at present managed, is singularly inefficient as a channel of correspondence." A part of the remedy was simple, and within the reach of the Harbour Commissioners. App. B. No. 53.

The income of the harbour is about 6000*l.* a-year, arising from tonnage dues, ballast dues, and pilotage, but only about one-third of this sum is applicable to the improvement of the port, as the pilotage and ballast dues barely meet the demands on them; yet 2000*l.* a-year steadily laid out in improvements on a systematic plan will do a great deal, and it would be difficult to discover in what works such a sum has been laid out for the last 20 years, unless it be in the hulks and gangways, which, it is to be feared, may prove a source of constant expense; the number of salaried officers appears unnecessarily great, and more than the small income would seem to warrant. The expense of the dredging-machine built specially for the port, and of the alterations consequent upon the ladder being at first too long, and now too short, has been heavy; the cost of dredging also is far higher than at any other port; 6½*d.* per ton would be a fair average, including landing, while here it is 9¾*d.* per ton; and the highly objectionable practice has hitherto been pursued of throwing the soil overboard in the deep water of the King's Channel. App. B. Ev. p. 89. App. B. Ev. p. 91.

Seeing this constant source of outlay, in a harbour where there is so great a tendency to deposit soft mud, it may be worthy of very mature consideration whether some simple turnwater, on a similar plan to, but less expensive than, that proposed by Mr. Cubitt, might not be the most economical measure in the end, and this arrangement would leave the dredger free to deepen the channel either at the ford or over the bar. Captain Frazer, R.N., has suggested a moveable one; and this, if carefully watched, would probably be the best. At first this would, of course, be an additional expense; but looking at the great increase of traffic in the port, which in 1816 counted only 700 arrivals, and now numbers 1650 a-year, such an outlay would seem to be fully warranted.

The pilot establishment of the port consists of 33 pilots, and 10 assistants, under direction of the pilot master, who resides at Passage; they pass an examination before a committee of the Harbour Board, and are paid by salary and not by their earnings. This mode of payment is not likely to incite them to exertion, and we must not be surprised to hear that a merchant of New Ross declares, that their neglect to give assistance to his vessel was the cause of her wreck; and that sundry other complaints of their not being found at their stations, have reached this Commission.

It is high water at Waterford at full, and change of the moon at 6 o'clock. Ordinary spring-tides range 13 feet; equinoctial tides as much as 16 feet; neaps 8 feet, or 10½ feet above the level of low-water springs. The rate of stream is about three knots, and five knots in freshes, at which time great deposits of mud are brought down from the upper country.

The river Suir rises near Borrisroe, in the north-eastern part of the county of Tipperary, at about 700 feet above the sea, and receiving in its course 11 tributaries, it flows by Thurles,

APPENDIX A.
WATERFORD.
No. 4.
Report of the Examining Commissioner.

Cahir, Clonmel, and Carrick, to Waterford. Its length of course is about 100 miles, the first half of which is in a general southerly direction, then easterly, till it joins the united stream of the Nore and the Barrow. The latter river boldly competes with the Suir, both in length and volume, and considerably exceeds it in commercial importance. The approximate area of the rain or catchment basin of these rivers is 3,400 square miles, second only to that of the Shannon in extent.

6 & 7 Will. IV. c. 90.

The Suir Navigation Company were incorporated in the year 1836, for the purpose of cutting a channel at Carrick, and maintaining and improving the navigation of the river from Granagh Ferry to the old bridge at Carrick. Since that time the Company have in a very spirited manner laid out 10,000*l.* in opening a channel 420 yards long, through a ledge of rocks which crosses the river below the town, and in making an embankment 1,700 yards long, which has materially deepened the channel. This embankment still requires to be extended a mile farther, and some sand-banks in the river should be dredged away.

The tide is said to rise nine feet in springs, and five feet in neaps, at the quays of Carrick, and the river is navigable thus far for vessels of 180 tons, and 10 miles higher up to the thriving town of Clonmel, for barges of 30 tons burthen; but this navigation is capable of great improvement were the obstacles removed, and all agree that the chief of these obstacles, and the one that meets them *in limine*, is Waterford Bridge, with its narrow portcullis only 10 yards wide. On one occasion, a Government steamer, requiring to go up the river to Fiddown, was obliged to take the floats off her paddle-wheels, in order to pass through.

In the last year 154 vessels, of 10,187 tons, passed through this bridge, and discharged their cargoes up the river within the limits of the Navigation Company's Act; all these vessels were compelled to pay the Waterford Harbour dues, as well as the bridge tolls, yet the Waterford Commissioners contribute nothing towards the improvement of the upper part of the navigation.

Just below the confluence of the Barrow a tract of the strand, 1,000 acres in extent, in Dumbrody Bay, on the Wexford shore of the estuary, is in the course of embankment by the Board of Public Works. Off Passage there is fine deep water with sheltered anchorage, but the old docks there are filled up with sand and shingle, and there seems little hope of their being restored. At Ballyhack is a pier which affords shelter to coasters, and is useful at tide time for steamers to land, but mooring-rings and posts are wanted. At Arthurstown a pier was built a few years since, at a cost of 1,560*l.*, of which one-half was liberally contributed by Lord Templemore; it is very useful for coasting-vessels, fishing-boats, and the steamers that call here.

Duncannon has a small fishing pier and quay about 100 yards in length; but much more accommodation is required for the coasting trade, the river steamers, and especially for the vessels belonging to a fishing company recently established here, and which has been very successful in supplying fish for the country around as well as for the London market. A low-water pier or landing-place is much wanted, as well as the removal of the rocks which impede the entrance to the basin. A slight rubble-stone breakwater, extending across the rocks from the shore towards the pier-head, would stop much of the range of the sea at high water, and even at the risk of causing some deposit of sand, would be desirable.

There is a ship-yard on the Kilkenny side of the river at Waterford, where is a patent slip; there are also a graving bank, and a graving dock, the latter not yet completed. About 100 men and boys are employed in ship-building. Here are also two principal foundries and machine shops; an iron vessel is on the stocks, and any repairs of machinery can be carried out. There are only three cranes of small power on the quays. Water is abundant, and led down to the quay on the north side, but not on the Waterford side of the river. Large blocks of building stone may be obtained at the lime-stone quarries of Granagh.

The NUMBER and TONNAGE of VESSELS belonging to the Port, and of Arrivals and Sailings in 1845:—

—	Belonging to the Port.				Coastways.				British Colonies and Foreign.			
	Under 50 Tons.		50 Tons & upwards.		Inwards.		Outwards.		Inwards.		Outwards.	
	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.
Sailing Vessels .	65	1,611	121	21,437	1,322	110,040	1,109	84,073	99	20,800	64	14,508
Steamers . .	..	..	4	937	230	51,888	230	51,846	..	..	..	..
Total .	65	1,611	125	22,374	1,552	161,928	1,339	135,919	99	20,800	64	14,508

Not including wind-bound vessels, nor those bound to the port of New Ross.

The gross produce of the customs for 1845, was 162,804*l.* The population of Waterford, in 1841, was 29,288. Number of seamen about 1500, of which 1000 are registered. The Waterford fishery district comprises 76 miles of coast; and in 1845, had 347 fishing vessels and boats, employing 1398 men and boys. The Waterford Fishing Company, whose head-quarters are at Dunmore, under the active superintendence of Mr. J. W. Strangman, have 12 cutters, of from 36 to 50 tons each, all engaged in trawl fishing, and with great success; they are enabled to supply the poor with abundance of cheap nutritious food, and their example is well worthy of imitation in other parts of Ireland.

No. 4.
Report of the Examining Commissioner.

App. B. Ev. p. 91.
App. B. No. 144.

The approach to Waterford is well lighted by a fixed bright light at the Hook, at 139 feet above the sea, placed in 1791; by a red light at Dunmore Pier Head, 46 feet high; and by two leading lights at Duncannon, which lead over the bar: all these lights are maintained in excellent order by the Ballast Board of Dublin, and all acknowledge their brilliancy. It was, however, stated in evidence that seafaring men are of opinion that it would be an advantage to have the Hook Tower painted in broad bands of red, or black and white, in order to render it more distinct in hazy weather; and it will be seen from his letter printed in the Appendix, that Captain Beechey, R.N., is strongly in favour of this principle, which has been partially adopted at the Maidens, and at the Point of Air Lighthouse, at the entrance of the river Dee; but the greater part of the Tower, when to be seen against the sky, should be of a dark colour. From the records of the harbour we learn that in July, 1817, an application was made to the Ballast Board of Dublin, to place a perch and bell upon the Coningbeg Rock, which lies directly in the track of all vessels between Waterford and Milford or Bristol; in June, 1819, the danger had become so much more pressing, that they applied to have a light placed near the same; four months later, on occasion of a West Indiaman being wrecked there, and 26 lives lost, an earnest appeal was made in the same quarter, which was at length successful in obtaining a floating light, placed in 1824, or five years later; this vessel, however, in blowing weather, at the time it is most needed, is said to roll so heavily, that her lights are in a great measure rendered useless.

App. B. Ev. p. 91.
App. B. Ev. p. 92.
App. B. Ev. p. 92.

The chief grounds of complaint at Waterford are—that extensive accumulations of mud are permitted to remain at the foot of the quays; that the soil dredged up in shallow parts of the harbour, is dropped into the stream in the deep water of the King's Channel; that thousands of tons of refuse stone have been swept into the river from the quarries at Granagh; that the master of the Government mail-packet has frequently found the navigation of the river obstructed by stones thrown out by lighters; that the eastern end of the Burchall bank has considerably increased within the last few years; and that since the present pilot-master has known the port, the depth of water has decreased in many places over the shoals and banks. That the Ford Channel still requires to be dredged, as well as the Cheek Point Shoal and the Bar; that buoys are wanting on Broomhill, and especially on Seed's Bank, a dangerous spit, which extends two-thirds across the river.

Answers to printed queries.

The ladder of the dredging vessel, built expressly for Waterford Harbour, is represented to be too short, so that she can only dredge at certain places and at certain times of tide; the cost of dredging is 9$\frac{3}{8}$*d.* a ton, or nearly double the price at which soil is raised in most other harbours. The pilots are paid by salaries, and not by their earnings; and a heavy complaint is made by a merchant of New Ross, that the neglect of the Waterford pilots was the cause of the loss of his vessel on Drumore Bank, for which he could get no redress from the Ballast Board, nor even get the statement of his case fairly listened to.

No. 52, Ev. p. 92.

The Carrick-on-Suir Navigation Company complain that while they pay the Waterford Harbour dues, no part of the fund is laid out on the improvement of the upper part of the river; and that Waterford Bridge, with its 39 narrow arches, and an opening for ships only 10 yards wide, places a bar to the extension of navigation and improvement towards the towns of Carrick-on-Suir and Clonmel.

JOHN WASHINGTON.

APPENDIX A.
DUNMORE.
No. 5.
Report of the Examining Commissioner.

No. 5.

DUNMORE HARBOUR.

DUNMORE immediately within the entrance of Waterford Harbour, on the west side, is a small pier-harbour, formed for the accommodation of the Government mail-packets between Waterford and Milford. It contains an area of 3¾ acres at low water, inclosed by piers extending from the shore to a depth of 17 feet at low water and 28 feet at high-water springs, with an entrance between of 120 yards in width. The Eastern Pier is built of large rubble conglomerate, and red sand-stone from the neighbourhood, with an average sea slope of 3 to 1. It is 270 yards in length and 57 yards wide at the base. It has a pier-head light (red) 46 feet above the level of high water.

In 1814 Mr. Alexander Nimmo submitted a plan for a harbour in Portcallin Cove, now called Dunmore. In the following year Sir Charles Coote and Mr. Nimmo were desired to examine jointly the plan, and reported favourably on this position for a packet station, and the mole was immediately begun under the superintendence of Mr. Nimmo. In 1821 Mr. Telford examined the works, and reported well of them, and that he would not recommend any farther extension of the pier. The sailing packets were shortly after stationed here, and the harbour proved to be convenient in position, although much too small. In 1825 the sailing vessels were replaced by steamers, and these, in 1837, were transferred to Waterford, which has since been their station.

App. B No. 59.

App. B. No. 57.

In 1832 so much damage had arisen to the sea slope of the mole, that Mr. Halpin reported "that the pavement had been broken up and breached through almost its whole length; and the breaches were widening and advancing towards the pier-head every storm. At the inner points of the jetty, the depth had diminished 10 feet, arising from the stones washed round the pier-head; at the outer point it had diminished more than 20 feet." Very extensive repairs took place in consequence. On examining the sea slope on the 6th September last, in company with Captain Frazer, of H.M.S. "Lucifer," and William Davis, chief boatman, eight years resident on the spot, it was found that there were cracks in the masonry, and some of the landing steps were displaced; also that many large stones, formerly washed from the sea slope by south-easterly gales, now form a spit from the pier-head 110 feet long, projecting in a slanting direction across the harbour's mouth, and dry at low water. There has been considerable silting or filling up over the harbour; alongside the quays as much as eight feet, and generally about six feet. This harbour, including repairs, is said to have cost 100,000*l.* of public money, yet although no longer needed for the purpose for which it was originally intended, its value to the fishery is so great that we cannot consider the outlay ill bestowed.

App. B. No. 60.

Dunmore is now the head-quarters of a public-spirited and well-managed fishing company, under the superintendence of Mr. J. W. Strangman, of Waterford, owning 12 cutters from 36 to 50 tons each. The gross produce of the fish caught by these vessels during the last year is estimated at 4,200*l.* or 350*l.* per vessel, affording good, nutritious, and cheap food for the poor; thus offering a striking proof of the advantages resulting from a safe harbour in the neighbourhood of the fishing-ground, and proving what is really one of the chief things needful to develop the full extent and capability of the fisheries around the coasts of Ireland.

App. B. No. 56.

JOHN WASHINGTON.

No. 6.

NEW ROSS.

No. 6.
Report of the Examining Commissioner.

New Ross lies on the east bank of the River Barrow, at 10 miles above its junction with the Suir. The river here is from 200 to 300 yards wide, and has depths varying from 15 to 26 feet at low water. From the recent Admiralty survey of this river, made by Capt. Frazer and his assistant Lieut. Smith, R.N., it appears that at about 8 miles below the bridge, the Kenny Sand stretches across the river for a length of 650 yards, and forms a bar, having only 8 feet over it at low-water springs. The rise of tide at the quays is 9½ feet on neaps, and 13 feet on springs, which enables loaded vessels of 800 tons to pass up and discharge their cargo at the quays.

App. B. No. 51.

New Ross was formerly a dependency of Waterford, but in 1840 it was made an independent shipping port; it is now under the management of the Town Commissioners, but they have no power to levy increased tolls, and from want of funds the river is in a very neglected state. The chief obstructions are Stoke's Town Point, at 3¾ miles below the bridge, Lucy Rock on the opposite shore, Red Bank, the Seven Acre Patch, the West Channel Rock, the Bar, which requires to be deepened to 12 feet at low water, and three wrecks which lie in the channel, and which the Commissioners state they cannot remove from want of means. The only dues levied on shipping are 2*s*. 6*d* on each mast or top, and 1*s*. on coasters; these produce about 150*l*. a-year; out of this the water-bailiff's salary is 30*l*., and the rest is expended on repairs of quays, mooring-rings, &c.

The pilots pass no examination; there are three licensed pilots, but boatmen take charge of vessels irregularly, and one was lost on Lucy Rock in consequence. Warping and mooring-buoys are much wanted. Ballast is thrown over and stones are washed from the quay, and the water-bailiff states that he has no power to prevent it. The foot of the quays is encumbered with mud. Here is a timber bridge, built in 1796, at a cost of 11,200*l*.; it is 170 yards long, with a solid causeway of 50 yards, and a portcullis not 9 yards wide, which is a great hindrance to navigation; a toll of 1*s*. is levied for it on each mast that passes up or down; this is considered a grievance, and much complained of. This bridge is said, also, to be the cause of a great deposit of sand and mud at the foot of the quays.

Number and Tonnage of Vessels belonging to the *Port*, and of Arrivals and Sailings in 1845.

	Belonging to the Port.				Coastways.				British, Foreign and Colonial.			
	Under 50 Tons		50 Tons & upwards.		Inwards.		Outwards.		Inwards.		Outwards.	
	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.
Sailing Vessels .	3	91	16	5418	597	43,326	167	9063	22	6378	21	6402
Steamers . . .	.	..	2	183	..	..	..	..	..	..	..	..
Total . .	3	91	18	5631	597	43,326	167	9063	22	6378	21	6402

The gross produce of the customs duties in 1844 was 22,735*l*. The chief exports are grain, flour, wool, butter and bacon. Two steamers ply regularly to Waterford. Population, 7543 in 1841. Number of seamen 240. The trade of the port is increasing.

The River Nore joins the Barrow 2 miles above New Ross; and the tide flows up that river to Inistiogue, and by the Barrow 10 miles to St. Mullins: barges go up still higher to Athy, where the junction of the river with the Grand Canal affords water communication with Dublin on the one side and with Limerick on the other, so that few towns in Ireland are more advantageously situated for trade than New Ross, and yet from want of a proper Harbour Board, with power to levy the requisite dues for improving the river, and from want of authority to restrain the unlicensed conduct of the pilots or boatmen, there are few places in which such advantages of position are so entirely thrown away.

John Washington.

APPENDIX A.

LIMERICK.

No. 7.
Report of the Examining Commissioner.

No. 7.

PORT OF LIMERICK.

AT the head of the estuary of the Shannon,—the noblest river in the United Kingdom, now by the liberal grants of Government rendered navigable almost throughout its whole length,—and shortly to be connected by railway with Dublin, Cork, Waterford, and Ennis, Limerick occupies an admirable position for trans-atlantic trade and commercial enterprise.

These advantages of position, however, are at present thrown away, and the enterprise of her merchants is paralysed by the obstructions in the river navigation immediately below the city, and by the insecure state of the harbour where ships are exposed to every storm.

4 Geo. IV. c. 94.

Prior to 1823 the management of the port of Limerick was in the hands of the corporation of the city. In that year an Act was passed "for building a bridge across the river Shannon, and the construction of a floating dock, to accommodate large vessels frequenting the port," "without which,' the Act recites, "the bridge could not be erected or built with convenience to the trade of the said city." By this Act, certain gentlemen connected with the county and city of Limerick and county of Clare were incorporated under the title of the "Limerick Bridge Commissioners;" and by a clause in the Act they were empowered to raise such sums of money as they might require for the purposes therein contained. Under this power, the Commissioners borrowed 80,000*l*. of the Board of Public Works, for the repayment of the principal and interest of which, the merchants and traders of Limerick consented to the imposition of heavy rates and duties on their trade and shipping.

4 & 5 Will. IV. c. 84.

Clause 11.

In 1834, the trade of the port having greatly increased, it was found requisite to extend the powers of the former Act, for the purpose of building additional quays and docks. The preamble to this amended Act recites that "the money heretofore expended upon the works has been almost altogether employed in the erection of the bridge and communication across the river, or in buildings connected therewith, and the shipping have as yet received no advantage from these works, whilst the trade and shipping have been subjected to very heavy rates and duties which were imposed by the former Act, in consideration of the benefit which the shipping trade would derive from the completion of a floating dock," &c. The Act goes on to appoint three additional Commissioners, and authorizes the advance of a sum not exceeding 200,000*l*., for the purposes of the Act, upon the credit of the tolls and duties, "and which sum was to be advanced, although the tolls, &c., were not of sufficient amount for the repayment of such loans, and although the actual or expected receipt or produce of the works should not be adequate to discharge the sum to be advanced within 20 years"

In virtue of this authority the further sum of 45,000*l*. was borrowed, and was expended in building additional public quays, and in making compensation to proprietors, but no docks were built; the trade and shipping interest of the port, however, were subjected to a further increase of taxation, in order to repay the principal and interest of this whole debt of 125,000*l*.; two-thirds of which sum, it is shown by the recital of the Act, had been expended in building a bridge, which, however ornamental it may be, and certainly is, to the town, is a positive obstruction to the harbour, and has already been, to a great extent, the cause of loss and damage to the shipping of the Port.

Limerick Harbour is formed by the town-reach of the river Shannon, which, from Thomond Bridge to Mead's Quay, extends, in a general west direction, 1600 yards in length, by 150 yards of average breath. The depths in this portion vary from two to nine feet at low water, over an extremely irregular rocky bottom, but with the great advantage of a 19 feet rise of tide on springs—thus enabling vessels of 600 tons to go up and discharge their cargoes at the quays.

The harbour is divided in two, nearly about the middle of its length, by the Wellesley Bridge, which has a portcullis to allow vessels to pass, and an open lock or passage capable of containing four small vessels; the custom-house, and the old and most secure part of the harbour (the resort of the numerous turf-boats) are above the bridge; but the greater part of the traffic is carried on below alongside the quays, which extend on the south side of the river for a length of about 900 yards.

In this lower portion, which rather deserves the name of a roadstead than a harbour, vessels lie aground at low water, upon a hard uneven bottom, exposed to the whole strength of the tide, increased by the occasional freshes of a vast river, and to the full fetch of westerly gales which, in the storms of 1839 and 1842, caused loss and damage to shipping and goods exceeding 24,000*l*.

Yet, such is the elasticity of trade, and especially of foreign trade, that in spite of all these drawbacks, there has been a rapid increase in the trade and shipping tonnage of Limerick. About 20 years ago there was scarcely a vessel belonging to the port; there are now 116 vessels, registering 15,415 tons, some of which exceed 600 tons in burthen. In 1824, the number of vessels reported inwards was only 156; they are now 597, with a tonnage of 74,213. Twenty years ago, the harbour duties were only 1262*l*.; they are now 3768*l*. At the same period the custom duties were 66,929*l*.; they now yield 192,975*l*.; or in both cases have more than trebled in amount during the last 20 years.

If then such has been the advance, despite all the above-mentioned difficulties, it is fair to

Appendix A.

Limerick.

No. 7.

Report of the Examining Commissioner.

expect a much more rapid increase if the port were only provided with the usual accommodation of a floating-dock; an increase that would in a few years more than repay the necessary expenditure. Limerick too possesses every facility and advantage for the construction of such a dock, in the flat nature of the shores, the great rise and fall of tide, and the abundance of excellent building stone in the immediate neighbourhood, all of which would contribute to render its execution rapid, easy, and economical. Why then should such a measure be delayed?

The earliest chart of the Shannon is that of Murdoch Mackenzie, made about the year 1763; this gives the general features of the estuary, and points out the several anchorages correctly, but furnishes few details. In 1831, Capt. Mudge, R.N., made a detailed report on the state of the river from Limerick to the sea, a distance of 50 miles, in which he pointed out the several rocks, shoals, and impediments to the navigation of the upper part of the river between the city and Grass Island, a distance of 13 nautic miles, as well as the generally neglected state of the river from that island to the sea, the want of a light on the Beeves, and generally of the want of buoys and beacons throughout. This report was laid before Parliament; and in July, 1834, a Select Committee of the House of Commons reported, "That your Committee approve most cordially of the improvements suggested in the valuable report of Captain Mudge, and earnestly hope they may be shortly executed." App. B. No. 77.

In 1833, Mr. Rhodes, C.E., made a plan for improving the port of Limerick, and proposed placing a weir across the river at Kelly's Quay, and thus converting the whole of the upper portion of the river into a floating dock, at an estimate of 53,730*l*. (App. B. No. 78.) Ten years later, Messrs. Rhodes and Owen made a joint report in favour of this proposal, but which, happily for the port of Limerick, has not yet been carried into effect. (App. B. No. 87.) Indeed all parties now seem to have agreed that Mead's Quay is the right place for a floating dock, and the ground there is actually purchased for this purpose, and in possession of Government.

In addition to these several reports, all stating strongly the necessity of floating docks, various memorials from the Bridge Commissioners, from the Chamber of Commerce, and from the Grand Juries, have, from time to time, been presented to the Treasury and to Parliament, urging the pressing necessity of advancing money to enable this object to be carried out, and stating the certainty of such a measure being attended with a corresponding increase in the trade of the port. App. B. Nos. 82, 86, 286, 287.

On attentively considering these various Reports and memorials, the recommendation of the Select Committee of the House of Commons, in 1834, and the amended Act of Parliament of the 5th of William IV., it appears that it would be but an act of justice, as well as of policy on the part of Government, either to carry out the spirit and obvious intentions of that Act by constructing a sufficient floating dock, or to repeal so much of it as will enable the merchants of Limerick to build such a dock for themselves, which they cannot do so long as that Act remains in force, whereby the increased dues or tolls would be payable to the Board of Works, and not to the merchants, or others, who might bear the expense of making the docks. 4 & 5 Will. IV. c. 84

The insecure state of the present harbour may be judged of when it is mentioned that, on the 6th and 7th January, 1839, in a heavy storm, several vessels broke from their moorings, and were dashed against Wellesley Bridge, causing serious damage. On the 26th January, 1842, a still heavier gale occurred, which damaged more or less every vessel in the harbour, drove many of them against the bridge, and tore down the whole of the parapet and cornice on the south side. The damage done in these two storms to shipping and their cargoes was estimated at 24,000*l*., or more than two-thirds of the whole sum required to construct a floating dock. App. B. Nos. 79, 83.

Hitherto no detailed survey of the Shannon had been made, but in 1838 the Admiralty directed Captain Wolfe to proceed on that service, which occupied him and his assistants, Lieutenants Church and Beechey, for three years; the result is a series of valuable charts, published in six sheets, on the scale of 4½ and 7 inches to a mile, besides detailed plans on a larger scale of Limerick Harbour, Foynes, Tarbert, &c., accompanied by a book of sailing directions, so that henceforward there is a sure foundation on which to base any plans for the improvement of the navigation of the river. (See Plan, p. 144.) In the course of his survey, Capt. Wolfe called the attention of the Limerick Commissioners to the unimproved state of the river, which even a few hundred pounds would materially remedy, and pointed out that the buoy that once marked the northern point of the Scarlet Reef was lying among the rocks, and only required stanching to resume its duties. App. B. No. 81.

There are 72 Limerick Bridge Commissioners; 42 are for life, and 15 are biennially elected by the rate-payers of the port; 12 of these latter are ship-owners. The income of the port is about 4000*l*. a year; but as the whole of this sum is mortgaged to the Board of Public Works, the Commissioners have no power to expend one shilling on the harbour: and it is stated that the reply to every application for improvement is, "that there are no funds." It appears in evidence that the Shannon Commissioners originally proposed to effect improvements in the port, but that the Bridge Commissioners declined their assistance, in the belief that they would get funds to construct a floating-dock; in this, however, they were unsuccessful. App B. Ev. p. 132.

The NUMBER and TONNAGE of VESSELS belonging to the Port, and of Arrivals and Sailings in 1845 :—

—	Belonging to the Port.				Coastways.				British Colonies and Foreign.			
	Under 50 Tons.		50 Tons & upwards.		Inwards.		Outwards.		Inwards.		Outwards.	
	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.
Sailing Vessels .	46	1,299	68	13,816	521	57,118	653	74,529	76	17,095	3	477
Steamers . . .	..	..	2	300	..	..	..	..	..	..	..	..
Total .	46	1,299	70	14,116	521	57,118	653	74,529	76	17,095	3	477

Gross produce of the customs, 192,975*l.*; population of the city, 48,391, in 1841; seamen employed, 700; coasters, 300; fishermen, 500; boatmen, 100; total sea-faring population, 1600. There are three building slips, and one patent slip for 500 tons, and about 100 men employed ship building; 1600 yards of quayage and wharfage, and 5 cranes, 2 of them capable of lifting 7 tons. Two river steamers of 150 tons, and 80 horse power each; one of them plies daily to Tarbert and Kilrush. There is a resident engineer, an experienced harbour-master, and 50 pilots belonging to the port; the latter pass an examination before a Pilot Committee and the Harbour-master, and are furnished with useful regulations; they are very properly paid by their earnings, and not by salary, as in many other ports.

The entrance of the Shannon between Loop Head on the north, and Kerry Head on the south, is nine miles wide; eight miles higher up the width abruptly contracts to less than two miles, and this may be taken as the average breadth as far as Tarbert, where it is reduced to one mile, whence it gradually decreases up to Limerick at 50 miles from the sea.

Admiralty Sailing Directions, p. 19. The approach to the river is lighted by a fixed bright light at Loop-Head, 269 feet above the sea, and visible 20 miles; a fixed red light at Kilcradan, 133 feet high; and a fixed bright light at Tarbert Rock, 58 feet high, there are no lights farther up the river; but one is much wanted at the Beeves.

The Shannon possesses the great advantage of being easy of access; its entrance being broad, free from dangers, and lying on a parallel of latitude, may be boldly run for. Having made Loop Head, vessels caught in a westerly gale may fearlessly run for shelter to Carrigaholt-road, or if bound up the river, to Scattery or Tarbert-road.

App. B. No. 73. The Loop Head and other lights above mentioned, placed by the Ballast Board of Dublin, are brilliant and efficient; but immediately to the southward of the entrance of the Shannon, there is great need of a light on the Foze Rock, the most western point of Ireland. Captain Wolfe says, "this want is much felt by the Limerick traders, who having lost sight of the Loop Head light, have no means of ensuring their being far enough to the westward to bear up to make the Skelligs. The distance between Loop Head and the Foze Rock is 40 miles, and from the Foze to the Skelligs 16 miles, making a distance of 56 miles, without any light on a coast which is the general landfall of all vessels coming from America."

The first secure anchorage from westerly gales at the mouth of the Shannon is Carrigaholt, on the northern, or Clare shore, immediately within Kilcradan Head. Here is a small pier accessible only to boats at high water.

Kilrush, a thriving town of much traffic, with numerous fishing-vessels and turf-boats, lies 7 miles higher up the river on the same shore. The anchorage here in Scattery Road, under the lee of the island, is the best stopping place in the river. Close over on the north shore is a dangerous rock, the Wolf, which should have a perch on it or be blasted away.

The creek, or natural harbour of Kilrush, is dry at low water; it has already been improved, and is capable of still further improvement; it has two quays and a patent slip. About a quarter of a mile to the eastward of the harbour is a pier, at which all vessels of any size take in their cargoes, and here the daily steamer from Limerick lands and embarks her passengers. This pier, originally built by the Revenue Board, ran out 70 yards from the shore, in a south direction, into about one foot depth of water at low spring tides; it was of upright work, built of rubble flagstones, and stood for years uninjured. In 1830 the pier was extended 57 yards to the S.S.W., into 7 feet at low-water springs. This portion of the pier is also upright; it is built of limestone ashlar, of sufficient, but of moderate scantling, and the body filled in with rubble. It was further extended 50 yards in 1843, by the Shannon Commissioners, under the superintendence of Lieut.-Col. Harry Jones, R. E. When examined in September last it appeared in good order, and it was stated that it had not cost one shilling for repairs since first completed. This pier presents a strong contrast to the insecure state of the piers built with a long slope to seaward, as at Dunmore and elsewhere around the coasts of Ireland.

Tarbert Road is the first, and may be considered the best, anchorage on the south or Kerry side of the estuary, at about 7 miles above Kilrush. Tarbert Island, or peninsula, at low water, is connected with the mainland by a causeway, now being raised above the level of high water. It is to be hoped this work may not cause silting up in the roadstead. A small timber pier, for the convenience of steamers, has lately been carried out from the north-western point of the island into 6 feet at low water.

Foynes Island, 9 miles higher up the river, and 20 miles below Limerick, is about three quarters of a mile in extent each way, and rises to a height of 200 feet. To the south and south-east of the island, between it and the mainland, is an excellent well-sheltered harbour, of about 60 acres in extent, capable of containing many vessels in depths from 3 to 6 fathoms water,

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the bottom being stiff mud, the best quality of holding ground. The entrance to the harbour from the north-west is quite clear and deep, that from the north-east is more intricate, and at low water time is only suited to small vessels.

Foynes is well situated as a converging point for the traffic of the north-western portion of the county of Limerick, a district rapidly advancing in industry and consequent prosperity. A shipping place for its agricultural produce is much wanted, and Foynes offers every facility for this purpose in its sheltered anchorage and ample depth of water. It is also in the immediate neighbourhood of the great high road to Limerick, and within three quarters of a mile of one of the finest limestone quarries in the south of Ireland.

Hitherto this harbour has been little used except by stone-boats; but there is no place in the Shannon so well adapted for the site of a commercial town, while on the island there are already natural docks, requiring but little assistance from art to render them serviceable.

A little below Foynes is the pier of Kilteery, which is said to have no traffic. On the coast of Clare, just opposite, is Kildysart pier, past which the spring tides sweep with such velocity that the steamers will not touch there, nor does the ferry-boat from the opposite shore land at it.

5 Geo. IV. c. 64.

These two piers are examples of the bad working of the clause of the Act of 1825, which requires local contributions as an indispensable condition before making a grant of public money. This clause has had the effect, occasionally, of fixing the construction of piers on inferior instead of on the best sites. Local contributions will rarely be obtained, except in a few public-spirited instances, but when the individual subscribing will derive personal advantage; he therefore proposes the site as the condition of his subscription; and although a preferable site may not be far distant, if local contribution cannot be obtained for it, the Act leaves no discretion to decide in its favour, and either the inferior site must be adopted or the measure be given up. The general principle of local contribution is good, but its universal and indispensable application practically renders the selection of the best sites impossible. Thus the thriving villages of Foynes and Glin are left without the accommodation they may justly claim, while Kilteery and Kildysart have piers, which apparently are of little if of any public benefit.

App. B. Ev. p. 132.

The river Fergus joins the Shannon from the north at 16 miles below Limerick; it is navigable as far as the bridge at Clare, two miles to the south of Ennis, the county town, which is situated in the centre of a rich and extensive agricultural district. At this point, a quay, after considerable delay, has recently been completed, but the access to it is still intricate and bad, yet might be much improved by a small expenditure; a boon that the increasing prosperity of this district appears fairly entitled to claim.

Nearly opposite the Fergus, on the south side of the Shannon, the small river Deel leads to the town of Askeaton, and thence communicates with the centre of the county of Limerick. It is stated that the trifling expenditure of 1500*l.* in deepening the river would enable sea-going vessels to get up to the town, and thus all the grain, the produce of a great corn district, could be exported direct, while coal, turf, and other articles essential to the comforts of the poor could be imported at a much more reasonable rate than at present.

Sailing Directions.

App. B. No. 72.

It was stated in evidence that the extension of the pier is much wanted at Beagh Castle, not only owing to the great traffic in corn and butter from that district, but from the benefit it would be to the numerous turf-boats that usually stop the tide there, and which, in stormy weather, get destroyed, and thus several lives had been lost. To this we may add the testimony of Captain Wolfe, R. N., who has recently completed the Admiralty survey of the river, and says—"The Shannon is at present in a much neglected state, without a single buoy throughout its entire length to mark any of its numerous dangers, or scarcely one convenient shipping place where a boat can land at low water." Again he says, "Not one buoy, and only one beacon exists throughout the extent of about 60 miles from Limerick to the Loop Head, the upper part of which is very intricate and dangerous. The buoy, belonging to Beal Bar, lies on the shore at Carrigaholt, and I have seen the iron buoy which marked the northern point of the Scarlet Rocks lying dry at low water, with its chain attached to it, and wanting merely to be staunched to cause it to float again".

As the resources of the country are developed, industrial activity must extend along the banks of the Shannon. This great river, draining an area of 4544 square miles; navigable from the ocean to its source, where it spreads at once into an extensive lake, surrounded with coal and turf, affording an abundant supply of fuel; flowing through a district containing some of the most fertile land in Ireland, capable of producing large returns of flax, corn, and cattle; admirably adapted for steam navigation from one end to the other; connected by canals with Dublin and the eastern coast, and opening to the Atlantic and the western world by a capacious estuary, with roadsteads ample for the largest merchant fleet, offers a combination of natural advantages hardly to be met with in any other part of the country.

One essential link, however, in the chain is wanting, a sheltered port of easy access, with a floating dock for the security of shipping;—this Limerick has not, but this Limerick easily might have, and ought to have, and without it the energy of her merchants is paralysed, and her natural advantages of position are, in a great measure, thrown away.

JOHN WASHINGTON.

Appendix A.

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PORT OF GALWAY.

Sheltered from the Atlantic swell by the natural breakwater of the Arran Isles, on the extreme west coast of Ireland, with a bold entrance on either side of them, and a direct channel to the roadstead and harbour at the head of the bay, Galway presents great natural advantages for rapid communication with Canada and the United States. It is already, in a limited sense, a harbour of refuge; and its proximity to, and proposed connexion by canal with, Loughs Corrib and Mask, extending 30 miles to the northward, and covering an area of about 65,000 acres, offers great facilities for the economical transport of merchandize to and from the interior.

The port and bay of Galway were, by charter of Henry VIII., placed under the control of the corporation; this power was confirmed to them by Edward VI. and by Elizabeth, who conferred on the mayor the title and authority of Admiral of the Port and Bay.

During the following century Galway became a town of some importance, its commercial relations with Spain and its exports of kelp were considerable, but its trade gradually diminished: so much so that, in the year 1830, the dues levied on shipping amounted only to 350*l.*

At this period the merchants, feeling great want of harbour accommodation, applied to the late Alexander Nimmo, C.E., who proposed a plan for the construction of new docks and quays, and for connecting Lough Corrib with the bay by a canal; and under this plan the Act 11 Geo. IV. c. 122. of 1830 was obtained. By this Act 63 Commissioners selected out of the neighbouring gentry were appointed, and empowered to raise the sum of 50,000*l.* at 5 per cent., for the purpose of carrying the proposed works into effect; they were required, among other things, "to print, publish, and circulate in the said town (Galway) a yearly account of the sums received and expended in each year." By a subsequent Act in 1831, the amount of loan was reduced and 1 & 2 Wm. IV. c. 54. restricted to 40,000*l.*, and so much as related to the right of priority of claim (in reference to loans) granted by the previous Act to the Board of Works was repealed.

Nimmo's proposal being considered too extensive by the Board of Works, Killaly was directed to prepare a modified plan, on which they consented to lend the sum of 24,000*l.* To this proposition the Galway Commissioners, although giving the preference to Nimmo's scheme, were under the necessity of acceding, and the docks were consequently constructed upon the plan of the latter. The area of the new floating dock is about five acres, with App. B. Ev. p. 147. a depth of from 13 to 14 feet of water, and a clear entrance of 54 feet in width, fit to receive vessels of 300 tons. So far these improvements have proved a great boon to the merchants of Galway, inasmuch as the *maximum* size of vessels trading to this port in 1835 did not exceed 120 tons, whereas now it has risen to 440 tons.

App. B. Ev. p. 149. The first chart of Galway we meet with is Mackenzie's, made in the year 1763; this does not enter into much detail, and has not noticed the Santa Margarita Rock, a dangerous shoal, half-way between Kilcorgan Point and Barna Cliff. The next is that of Nimmo, made for the Fishery Board, and published in the year 1822, on the scale of 1¾ inches to a nautic mile; it shows much more detail, and is accompanied by sailing directions. During the last two years an Admiralty survey of Galway Harbour and Bay has been made by Captain Bedford, R.N., and his assistants. This is a detailed survey, on the scale of 6 inches to a mile, and for the first time shows distinctly all the features of this extensive estuary, and the fine deep water which it carries from the sea up to the roadstead under Mutton Island.

Fishery Report, Ireland, 1836, App. pp. 102-3. The fishery at Galway forms more exclusively the occupation of a great part of the population than of any other town on the west coast; the fishermen inhabit the Claddagh, a beach on the west side of the river, and it is said they number 1000 families. The boats are stout, open, or half-decked hookers, from 5 to 15 tons' burthen. In accommodating these boats, the harbour of Galway is very defective; and Nimmo, in his "Coast Survey of Ireland," in 1826, observes, that it is much to be wished that something were done to remedy it. In strong freshes from Lough Corrib, the boats can hardly enter at any time, and especially at low water, and they are obliged to lie in the roads or in the pool below, where till of late they were much exposed to S. and S.E. winds, until the tide should flow to enable them to get up the Claddagh. Many years previous to Nimmo's Coast Survey, in 1771 and 1783, the Irish Parliament granted the sums of 500*l.* and 1000*l.* for repairing the Fishery Quays, and for the general improvement of the harbour; and about the year 1812, two narrow jetties were built across the beach at the Claddagh, which permitted more easy access to the boats when they floated; in 1822 this beach was deepened, the jetties were raised, and a rough quay along the shore was formed. A plan was proposed by Nimmo for improving these jetties, and for giving more effectual protection to the boats, but they were not carried into effect. Upon an application, however, of the merchants and fishermen for the improvement of the port, Nimmo was instructed by the Government to report thereon, and he advised the construction of a pier on the Slate Rock, which forms the western side of the entrance; this was done, and according to the accounts of the fishermen, it had the effect of deepening the water on the bar. Another of his propositions was to run a road or dyke, about 300 yards in length across the mouth of the creek, which separates the Point of the Slate Pier from Claddagh, thus forming a short cut to the Slate Pier, and also an additional quay for the fishing craft; the estimated expense of this was about 1014*l.* Nimmo further remarks,

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that the roadstead of Galway is protected by Mutton Island, half a mile off the shore, and that it would be an improvement to raise the strand which connects it with the main to high water level by a breakwater of rough stone, which would enable vessels in the roadstead to communicate more readily at any time with the shore; the expense was estimated under 8000*l.*; boats are frequently obliged to stop in the roads for the flood-tide, as the freshes from Lough Corrib run very strong on the ebb, and by means of this jetty there would be a communication with the shore at low water; stone for its construction may be got on the spot, by quarrying the rock into the pool on the east of the lighthouse on Mutton Island, and thus a good boat harbour might be formed at the same time; the improvement of this roadstead, he adds, would be a national object. App. B. No. 59.

In 1835, Captain Evans, R.N., who examined the western harbours of Ireland with reference to a packet station, was also of opinion that a breakwater should be run out two cables' length from the south end of Mutton Island, which would shelter a good anchorage with four fathoms at low-water springs: with this improvement, he adds, "Galway might become a commercial town of importance."

Captain Bedford, R.N., concurs in the above opinions, and in the want of a road connecting Claddagh with the Slate Quay; and in the event of a breakwater being built and the bar at the entrance of the dock removed, he anticipates a great increase of trade from the advantageous position of the port.

There is, however, one point that will require serious consideration with respect to a breakwater if extended from Mutton Island: might it not cause the roadstead partially to silt up? and, if so, would it not be better to place it sufficiently detached from the shore so as to allow a good stream of tide to pass between it and the island? The opening would slightly increase the expense of construction, but that is but a secondary object compared with the risk of causing a deposit. In the same manner it might be necessary to leave a free passage for the tide in the causeway proposed to connect Mutton Island with the Main.

As the present dock accommodation is not sufficient to meet the increase of trade which may naturally be expected to result from the improvement of the harbour, it becomes of importance to inquire what further accommodation the locality might be made capable of affording. At first sight, Lough Athalia would seem to offer an admirable site for a floating basin, having from 10 to 20 feet in it at low water; but it would be very difficult to clear a passage through the rocky gorge which connects it with the harbour, as we learn from Captain Bedford's Survey that the low-water level of the lake stands 9 feet above the corresponding level in the bay. See plan, p. 176. Looking, however, at the prospective increase of traffic, it is highly necessary that in all railroads that approach the town care should be taken to prevent the entrance to this Lough being so blocked up that it could not be turned to account, if required, at any future time. The space between Mutton Island and the mainland might perhaps afford more spacious and convenient dock accommodation than Lough Athalia, and the same work would furnish the breakwater and more ready communication with the shore and Claddagh recommended by Nimmo.

When we consider the increase in trade that has arisen from the limited improvements already carried out, namely, from 350*l.* fifteen years ago to 2000*l* in the past year, it is fair to anticipate that much greater results will follow. The whole of this income, however, is App. B. Ev. p. 146. mortgaged to liquidate the interest and to pay off the principal of the harbour debt, which, on the 1st of January, 1846, amounted to 22,757*l.*

NUMBER and TONNAGE of VESSELS belonging to the Port, and of Arrivals and Sailings in 1845:—

—	Belonging to the Port.				Coastways.				British Colonies and Foreign			
	Under 50 Tons.		50 Tons & upwards.		Inwards.		Outwards.		Inwards.		Outwards.	
	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels	Tons.	Vessels.	Tons.
Sailing Vessels .	6	104	13	2,953	108	12,222	177	21,483	24	5,291	13	2,907
Steamers . . .	..	..	..	..	..	..	..	..	..	..	..	..
Total .	6	104	13	2,953	108	12,222	177	21,483	24	5,291	13	2,907

By the Census of 1841, the town of Galway numbered 17,275 inhabitants. The extent and value of the coast and sea fisheries, which by fostering care might be greatly increased, may readily be conceived from the fact that they give employment to between 1800 and 2000 boats, App. B. Ev. p. 148. manned by about 8000 hardy fishermen, who form a valuable body of seamen; but the great distance of the fishing grounds, and the want of fishing piers for the boats to run to for shelter or to land their fish, are very much felt; in 1841, many hookers were lost in the bay in a gale of wind.

Galway Bay may be considered as limited by Gulin Head to the north, and Ballyclane Point, in the County of Clare, to the south, the distance between these headlands being 20 miles. About the centre of this space, extending 14 miles in a north-west and south-east direction, lie the lofty limestone ridges of the Arran Isles, presenting their mural cliffs to the south-west, and thus, as a natural breakwater, sheltering the bay and roadstead from the whole weight of the unbroken Atlantic swell.

The entrances, or sounds, to the north and south of these islands, are about 4 miles wide, with a depth of from 20 to 30 fathoms throughout. From the Arran Isles to Galway is 25 miles, and 4 miles farther to the head of the bay at Oranmore. Between Spiddal and Black Head, at half the distance, the bay abruptly narrows to 6½ miles, and retains this width to its end. The depths gradually decrease from 25 fathoms at Arran to 2 fathoms off Mutton Island, with fair holding ground throughout. The only danger is the Santa Margarita Rock, with 10½ feet water over it, lying about 2 miles W.S.W. of Mutton Island, and at an equal distance from Kilcorgan Point. This rock is buoyed, but it would be highly desirable that it should be blasted away.

The northern shore of the bay, at its western extreme, is broken up into rocky islands of granite, between which anchorage may be found, and specially in Greatman's Bay, and Costello, or Casleh Bay; here, and on Garumna Island, fishery piers were built by Nimmo out of public funds. Off the south end of Garumna, about half a mile off shore, lies the Englishmans Rock, which much requires a perch to mark it. The population of these islands is chiefly employed in collecting kelp and turf; and, being very poor, require any little assistance that can be given to improve their small harbours and remove some of the numerous rocks. The recent passage cut through the rocks at Bealdangan, by the Board of Public Works, under the direction of General Sir John Burgoyne, has been a great boon to them, and will be the means of saving many a boat from wreck.

Casleh Bay is the easternmost of the harbours of Connemara; the coast thence to Galway is nearly a straight shore, with low skars of granite, between which are some sandy coves. Inveran Creek, Spiddal, Furbough, and Barna, are the only places at which boats can land, and they afford very bad shelter. In this long range of coast, in the immediate neighbourhood of excellent fishing ground, it is extremely to be regretted that there is no good harbour; one safe low-water harbour, of easy access, about half way down the bay, would be a great help, not only to the fishing vessels, but to the numerous turf-boats, which are often caught here in a sudden gale, as was the case in April, 1841, when several hookers were lost.

Fishery Report, Ireland, 1846.

App. B. Ev. p. 151.

It appears from the recent Annual Fishery Reports, that there are 1871 fishing boats, hookers, and yawls, in this district, manned by 7958 men; yet, bold and fearless as the Claddagh fishermen proverbially are, it is not to be expected that they should risk their lives under such circumstances. A place called Greenbank, or Awleen, about 1½ miles below Spiddal, has been named as a desirable spot for a harbour; and it was stated in evidence, that Mr. Comyns, the owner of the neighbouring property, would grant 100 acres of land for establishing a fishing colony there, which would be a desirable object in many points of view. Should this spot, on examination, not be found fit for the purpose, doubtless some other in the neighbourhood might be found, and the expense of construction, where stone is so abundant and labour cheap, could not be very great; but, even if it were, surely it is a profitable investment of public money by which life is saved and a hardy race of seamen is encouraged. A shed or market, in which to deposit the fish when they bring it in, is also much wanted at the Claddagh.

The Clare coast, on the south side of the bay, is deeply indented; and this limestone district offers a great contrast to the straight line of granite coast on the opposite shore. The inlets of Black Head Bay, Kinvarra Harbour, Ballynacourty, New Harbour or Renville, and Oranmore, at the head of the bay, all afford shelter; and, during the war, the East India fleet is known to have awaited convoy in the deep water of Black Head Bay.

In the Arran Isles, Killaney Bay is the only shelter; it would be a great object to establish a harbour for hookers on one of these islands, as they are in the immediate neighbourhood of the fishing grounds. A good buoy, or perch, if it can be placed, is wanted on the Finnis Rock, off the south end of Inishere. A perch, also, is required on the Mantel Rock, and at Carrig-na-ruaig or Cockle Rook.

App. B. Ev. p. 150.

There is a revolving light on Arran, at a height of 413 feet above the sea, and, as may be supposed, it is often obscured by fog. A witness stated, that "in hazy weather he had often seen the rocks before he had seen the light." The lighthouse is painted white, which, seen against the sky, is the least distinct colour that could be adopted for hazy weather, or indeed for any weather, except when the sun shines bright.

Loughs Corrib, Mask, and Carra have recently been surveyed by Commander Beechey, R. N., and his assistant; these lakes communicate with the sea at Galway by a river three miles long. The area of Lough Corrib is about 43,485 statute acres; its length from north to south is 15 miles, its average width four miles; its depth is very variable, but, at a slight expense, it might be rendered navigable by vessels drawing from 7 to 10 feet of water.

Lough Mask is connected with Lough Corrib by a subterraneous channel, the lakes being separated by a ridge of land two miles wide; its area, including Lough Carra, which is an offset from it, is about 26,270 acres. The level of Lough Corrib is 32 feet in winter, and 29 feet in summer, above low water in the Bay; that of Lough Mask, according to the Ordnance survey, is 68 and 62 feet respectively above the same level.

In his admirable work on the Industrial Resources of Ireland, Professor Kane states that the area of the rain or catchment basin of these lakes is 1,374 square miles; their mean height of fall respectively is 36 and 14 feet, giving a water power equal to 6,850 horses available for industrial purposes.

To bring these lakes into navigable communication with each other and with the sea, would only require about 8 miles of canal; the direct length of navigation opened out would be about 30 miles, and a coast of nearly 200 miles would have a cheap and ready outlet for its agricultural and other produce, and must add largely to the trade of the port of Galway.

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The chief grounds of complaint at Galway are:—That, in carrying out the works, the contractors have not fulfilled their contract, to sink the bottom of the dock to five feet below low water, and to deepen the approach to the same level; that a rocky bar, 3 feet high, dry at low water, and on which a ship had broken her back, is left at the entrance to the docks, although it is said that 500*l.* would remove it; that the sum of 793*l.* was expended, in 1843, in repairing dock-gates put up only 2 or 3 years before; that the masonry of the east quay of the docks is so indifferent, that a light ship had knocked some of it away; that the whole of the dues are mortgaged to pay the principal, and interest at 5 per cent, of money borrowed to improve the harbour for the public benefit; and that the management of affairs is entirely taken out of the hands of the Commissioners by the Board of Public Works in Dublin.

App B. Ev. p. 148.

Complaints also are made of the too great elevation of the Arran light; of the necessity of a light on the Slate pier (from want of which many fishing vessels have been wrecked); of a road connecting Claddagh with the Slate Quay; of a breakwater off the end of Mutton Island; and of the want of buoys and perches on several dangerous rocks; that the fishery piers along the shores of the Bay are in a state of ruin, and nothing is done to restore them; and especial and well-founded complaint is made that the Claddagh fishermen, who, being obliged to go 30 miles distance to their fishing-grounds, have no harbour for which they can run if caught in a gale, whereby much hardship, and occasional wreck and loss of life, are incurred.

App. B. Ev. p. 150.

JOHN WASHINGTON.

No. 9.

PORT OF NEWRY AND CARLINGFORD LOUGH.

NEWRY.

No. 9.
Report of the Examining Commissioner.

CARLINGFORD LOUGH is a capacious natural inlet, affording 1200 acres of good anchorage, with a bar at its entrance having only nine feet depth at low water, but which is compensated, in some measure, by an 18 feet rise of tide, or the largest on the east coast of Ireland.

Once inside the bar, the Lough is navigable for six miles by vessels of the greatest burthen at all times; at tide time for two miles farther, to Warren Point, by vessels of 15 feet draft; thence four miles farther, by those of 14 feet, to Fatham, where is the present entrance of the canal, which carries 11 feet depth up to the town of Newry, at 14 miles distance from the sea.

29 Geo. II. c. 1, s. 14.
3 Geo. III. c. 1. s. 15.
5 Geo. III. c. 1, s. 7.
11 Geo III. c. 1, s. 7.
11, 12 Geo III. c. 1.
7 Geo. III. c. 1, s. 7.

The Newry Navigation connects Lough Carlingford and the Irish Sea with Lough Neagh and the surrounding districts, and by the Ulster Canal with Lough Erne and the west of Ireland. A canal from Fatham extends 25 miles northwards to the Upper Bann at Portadown, and the navigation thence by that river is about 15 miles to Bann Waterfoot on Lough Neagh. The summit level attained by the canal is only 22 feet above the Lough, and 50 feet above high water in Carlingford Bay. The depth of the canal from Newry to Portadown is five feet; there are 13 locks on the line; the width of the locks is 15 feet, and the canal is navigated by barges of 50 tons burthen; from Newry to Fatham the depth is 10¼ feet, and the lock is 22 feet wide. The upper portion of the navigation was finished in the year 1750, and from Newry to Fatham about 30 years later, and at the time of its completion it was considered a great national benefit. The whole of the works were originally constructed by Parliamentary grants: and since the beginning of this century a further sum of about 55,000*l.*, including tolls, has been expended on them, in repairs, by the Directors-General of Inland Navigation.

23 Geo. III. c. 33, s. 2.

27 Geo. III. c. 30.
33 Geo. III. c. 10.
10 Geo. IV. c. 126.

The traffic by the canal continued prosperous for many years, and the town of Newry rapidly rose in importance; but from mismanagement, arising from the ill-construction of the original Commission of 1787, the works were allowed to go out of repair, and the revenue, in consequence, fell off. In 1830 the Newry Navigation Company were incorporated, the property was made over to them, and they were authorised to levy certain tolls, upon condition of their expending a sum of not less than 80,000*l.*, within seven years, in keeping the works in repair, in the general improvement and extension of the navigation, and in deepening the river; otherwise the works should revert to the Commissioners of Inland Navigation, on payment of their value to the Company. This first period expired on the 26th July, 1837, but it has since been extended to July, 1848.

In fulfilment of the above conditions, it appears that the Company have expended 48,000*l.* (including the purchase of a steam-dredge) in widening and deepening the channel of the river from Doyle's Hole to Warren Point, and particularly at Narrow Water, whereby a large amount of tidal water has been admitted; and they have entered into a contract for 40,000*l.* for extending the present canal along the western side of the river, from Fatham to Doyle's Hole, and the erection of a ship-lock there. These works are in a forward state (it is said that 400 persons are employed on them), and, according to the contract, they should be completed in the course of this summer; it is to be feared, however, that this will not be the case. Unexpected difficulties have occurred in the construction of the eastern or left embankment of the canal, owing to the soft nature of the slob or mud land over which it is carried; in one place the embankment is said to have sunk 30 feet.

App. B. Ev. p. 220.

Since the navigation has been in the hands of the Company the income of the port has increased from 2400*l.* in 1830, to 4089*l.* in 1845, arising from dues on tonnage. The number and tonnage of sailing vessels belonging to the port, in 1845, was 50 of 50 tons and upwards, and 160 under 50 tons; their aggregate tonnage 10,900, and two steamers of 326 tons. The arrivals, in 1845, of sailing vessels in the cross-channel trade were 1315, of 68,252 tons; of steamers 219 vessels, of 46,063 tons; and in the British, foreign, and colonial trade, 64 vessels, of 9743 tons; total inwards, 1600 vessels, of 124,000 tons.

APPENDIX A.

NEWRY

No. 9.
Report of the Examining Commissioner.

App. B Ev. p. 222.

The engineering history of the port is briefly as follows:—About the year 1750 the canal terminated with a lock in the river just below Newry; to obtain an improved channel up to this spot, Golborne, C. E., of Chester, who had been similarly employed on the Boyne and the Clyde, recommended a new and straight cut for the river (which now goes by his name), and extends about 1½ miles through the marshes below the town. These marshes, either then or before, to the extent of 204 acres covered with three feet of water at spring tides, were embanked, and the tidal water excluded. As a natural consequence, the shoals below increased, and at Fatham, where was formerly a depth of from six to eight feet, it became dry at low water, till the deposit was dredged away by the Navigation Company. About 1780 the canal was carried three miles lower down to Fatham. In 1789, Mr. Richard Evans, civil engineer, reported on the state of the works, and gave plans for their improvement, but it does not seem that anything was done in consequence; and from that time to 1828, nothing of importance appears to have occurred.

App. B. No. 132.
App. B. No. 133.
App. B. No. 135.
App. B No. 134.

About that period Sir Thomas Page proposed to extend the canal from Fatham to the deep water in Rice's Bay, opposite Warren Point, at a cost of 136,000*l*. Mr. Killaly appears to have suggested a somewhat similar plan. In 1828, Mr. Alexander Nimmo was consulted on these plans, which he reported against, and recommended, in preference, deepening the natural channel of the river, so as to have 14 feet depth at neap tides all the way up to Newry, for which his estimate was 98,658*l*. Nimmo also pointed out that a cutting of only 22 feet in depth and three miles in length, through a soft soil, would bring the surface level of Lough Neagh through the valley towards Newry (it might also be brought to the town), and thus provide an inexhaustible reservoir of water both for the canal and river navigation, and open out the whole trade of the country; but nothing appears to have been done. In 1830, immediately upon the present Company obtaining possession of the works, Mr., (now Sir John) Rennie was consulted, who, after carefully considering the two plans, also recommended deepening the channel of the river up to Newry. Mr. Killaly appears to have reported a second time on this navigation, and proposed a canal from Fatham to the deep water at Doyle's Hole, with a ship lock there. The whole of these five plans and reports were referred to Mr. Brownrigg, who, in May, 1830, decided in favour of the canal to Doyle's Hole, with the addition of the deepening of the natural channel at Narrow Water as proposed by Mr. Rennie. At the same time Mr. Brownrigg plainly warned the Company that there would be great difficulties to encounter; that they would probably find a want of water to supply their canal; and that the aqueduct, a drain which passes under the present canal, would prevent their deepening it.

App. B. Ev. p. 220.

This plan, however, was decided upon, and now, after a lapse of 15 years, the canal is very far from being complete. And even if complete, we believe it is now generally admitted that it would have been more prudent to have carried out the proposal of Mr. Nimmo and Sir John Rennie, and to have deepened the natural channel of the river up to Newry. It is a significant fact, that a vessel of about 200 tons, of too great breadth of beam to pass through the present canal lock (22 feet), has lately sailed up the river, and discharged her cargo at the Newry Old Quay; such already have been the good results arising from dredging the river five feet in depth at Narrow Water. Compensation must yet be made in the channel of the river for the 204 acres of embanked land; it appears also that there are mill-dams and weirs across the river above the town, as at the Newry Mill, Damolly Mill, and Cairnbane, all of which are probably impediments to the fair flow of the tidal waters, which, for the benefit of navigation, should be encouraged to the utmost.

It is hardly necessary to remark, that to permit a fixed bridge, or indeed any bridge, across this river, as has been proposed by a railway company, would be a barrier to improvement and prejudicial to the best interests of the port of Newry.

See Plan, p. 238.

In 1831, a nautical survey of the bay was made by Captain Mudge and Lieutenant G. A. Frazer, R. N., and published by the Admiralty in the following year, on the scale of 1½ inches to a nautic mile, with sailing directions for the entrance. From this survey, it appears that it is high-water on the bar at full and change at 11^h; that the rise of tides is 18 feet on springs, and 12 feet on neaps; and that the velocity of the stream is 5½ miles an hour on springs, and 3½ miles on neaps. It is manifest that this is too rapid a tide either for the safety of navigation or for the preservation of the port, and any removal of obstructions at the entrance that would reduce its rate would be a benefit.

Up till the year 1823, a single light was placed on Cranfield Point, on the eastern side of the entrance, but since that time it has been discontinued, and instead, a revolving light placed on Greenore Point, and a fixed light 101 feet above high-water on Blockhouse Island; the above two lights in one lead over the bar, clear of the Helly Hunter Rock; a tide-light, below the fixed light, on the same tower, is shown at half-flood.

App. B. Ev. p. 222.

Warren Point lies 6¼ miles below Newry, on the County of Down shore; this is the station for the steamers and larger vessels, where they have a depth of about six feet at low water, with a rise of 16 feet on springs. The tidal basin here was constructed by a Parliamentary grant in 1767, but has been repaired and extended by the owner of the adjoining property, who now levies dues for the use of it and for quays; here is also a patent slip, recently completed, capable of admitting a vessel of 750 tons. There are complaints, however, of want of quay accommodation, of mooring-posts, and of cranes; of the want of means to prevent ballast and ashes being thrown overboard into the bay; of the want of a small pier-light at Warren Point, and generally of the want of buoys and beacons of sufficient size; of the inefficiency of the pilots, chiefly owing to their not being properly paid; but especial and well-founded complaints are made of the great impediment to navigation caused by the bar at the entrance at the Lough having over it only nine feet depth at low water.

APPENDIX A.

NEWRY.

No 9.
Report of the Examining Commissioner.

Carlingford Bay is one of the most important inlets on the east coast of Ireland; as before-mentioned, once inside the bar, it is navigable for six miles for vessels of the largest burthen at all times of tide, and affords upwards of 1000 acres of fair anchorage, although subject to a rapid tide, and to very heavy squalls off the mountains in westerly winds; but it is its position that makes its chief value, lying half way between Kingstown and Belfast Lough, a distance of 100 miles, in which there is no other harbour, except perhaps Strangford, that can be taken in an easterly gale. The number of wrecks in this neighbourhood is notorious: the *Herald*, *Tarbolton*, *Countess of Roden*, *Clarence*, *Peggy Arnott*, *Daisy*, *Diana*, *Speedwell*, *Mary*, and many others, but particularly the *John Stamp*, an Indiaman, from Bombay to Liverpool, in 1839, the value of whose cargo alone would have paid the cost of deepening the bar as much as is required to make this a harbour of refuge. App. B. Ev. p. 223.

Report for 1845 of Commissioners of Northern Lights.

Vessels that leave Liverpool with a southerly wind, making only a fair allowance for lee-way, will fetch over about this part of the coast; and as we know, from Parliamentary returns, that 15,300 vessels annually pay dues for the Calf of Man lights, not including ships in ballast, ships of war, revenue cruizers, fishing-smacks, &c., some notion may be formed of the vast amount of traffic that passes within about 30 miles of the entrance of Carlingford: the excellent lights, too, placed here by the Ballast Board of Dublin evince their sense of its importance.

App B. No. 136.

From the Report of Mr. Ramsay, resident engineer at Newry, who made a detailed examination of the bar in the year 1835, it appears to be composed of stiff blue clay, like pipe-clay, into which he bored 30 feet in depth without difficulty; on it and in the vicinity are numerous boulder-stones, marked rocks in the charts, which can easily be removed. The bar would seem to be an original formation, and not caused by deposit, and therefore, if once dredged away, there would be little fear of its return. To render this Bay available as a harbour of refuge, the bar should be deepened to at least 18 feet at low water spring tides, and this for a breadth of two cables' length, or 400 yards; the loose boulder-stones should all be picked up, the limestone skirts of Haulbowline Island should be removed, and the Earl and other rocks blasted away. The estimate for deepening the bar was 50,000*l*., but if even double that sum were required, it would be well bestowed in accomplishing that which could not fail to prove an invaluable boon to the numerous vessels navigating the Irish Sea, and, as such, is justly entitled to be considered an object of national importance.

JOHN WASHINGTON.

DROGHEDA.
River Boyne.

No. 10.

PORT AND HARBOUR OF DROGHEDA.

No. 10
Report of the Examining Commissioner.

The harbour of Drogheda is formed by the outfall of the River Boyne at four miles from the sea, and extends in an easterly direction about half a mile below the bridge, having a depth of from 16 to 18 feet at high water abreast the town quays.

3 Geo. II. c. 24.
33 Geo. II. c. I.
1 Geo. III. c. 1
22 Geo. III. c. 1.
24 Geo. III. c. 1.
30 Geo. III. c. 39.
37 Geo. III. c. 56.
48 Geo. III. c. 116
7 Geo. IV. c. 35.
5 Vic. c. 56.

The mayor, sheriffs, burgesses, and commons of Drogheda were in 1729 constituted Conservators of the river and port, and were empowered to erect a ballast office and to levy dues to be applied "to amending and cleansing the harbour." In 1759, and the following years, parliamentary grants to the extent of 6000*l*. were made in aid of deepening the river. In 1790 certain harbour commissioners were appointed, and in 1797 they were authorized to enclose the strand in order to build quays. In 1827 the provisions of the Act relative to the harbour commissioners were modified; additional powers were given to the commissioners, and they were authorized to raise 15,000*l*. on the security of the harbour tolls. They were also required to appoint and licence pilots; to fix the rates of pilotage; and to make bye laws for the government of the port. In 1842 an amended Act was obtained for the improvement of the port and harbour of Drogheda, which repealed all the former Acts; and the commissioners now consist of the mayor of the borough for the time being, and 27 others named in the Act, being persons resident within seven miles of the town. The qualification necessary for a commissioner, is 50*l*. a-year in property; or residence in a house valued at 25*l*. per annum; or 800*l*. of personal estate. One-third of the commissioners to go out every year, but subject to re-election. This Act gives power to borrow 70,000*l*.; and authorizes the commissioners to deepen and remove obstructions in the river as far up as Oldbridge. 5 Vic. c. 56, s. 60, 151.

Under the authority of these several Acts the town quays have been built and widened, the river has been narrowed and deepened, and a depth of several additional feet has been gained in the channel of the river.

The only plans of the port seem to be one made by Sherrard about the year 1786 prior to the works for deepening the river; that by Nimmo in 1826, which accompanied his report on the improvement of the harbour; and an unfinished plan by Bald, we believe, in 1837, on the scale of 16 inches to a statute mile, giving a longitudinal section of the river from the bridge to the bar, which shows the great irregularity in its bed. An Admiralty survey of the Bay of Drogheda, and of the soundings off the coast, was made in 1839 by Captain Frazer, R.N., and his assistants.

App. B. No. 140.
App. B. No. 291.

As far back as the year 1759 parliamentary grants to the extent of 6000*l.*, and local funds to the amount of 2700*l.*, were obtained and expended during the subsequent 20 years in improvements in the river. In 1783 Golborne, of Chester, the well known engineer who had been employed in deepening the Clyde, was consulted as to the best means of improving the Boyne; and he recommended, as in the former river, to narrow the channel to a width of about 80 yards by a series of longitudinal stone dykes, and transverse jetties to be projected at right angles from the banks of the river to low water mark. Some of these jetties were placed, and at particular spots an improved depth of water was obtained; but little general benefit arose, nor was the bar improved. Forty years later, in 1826, Nimmo was consulted, who recommended the employment of a steam dredge (then recently come into use on the Clyde) to cut through the shoals called Tickel's Bed, Rock Shod and Carrick, and Bankstown Ford; also to extend a rubble-stone mole or breakwater along the south edge of the North Bull Sand at the entrance of the river, to guide the stream of tide fairly over the bar, and to make an embankment from the North Crook to a point opposite the Maiden Tower, in order to afford shelter in north-east gales.

App. B. Ev. p. 236. In consequence of Nimmo's recommendation, a steam dredge was purchased in 1827 at an expense of 5000*l.*, and put into operation; and we believe that the Drogheda Harbour Commission are fully entitled to the credit of having been the first to introduce into Ireland the use of this valuable machine in the improvement of our harbours. The result has been a general increase of about four feet depth of water in the channel; and the revenue of the port, which in 1827 was only 700*l.*, now exceeds 3000*l.* a-year.

In 1837 Bald examined the river, and we regret not to have been able to meet with a copy of his report, but we believe it tended chiefly to recommend the continuance of the dredging, (a mode of improvement which he afterwards pursued with such good effect on the Clyde), and to connect the ends of the jetties by longitudinal walls.

Sir John Macneill is now consulting engineer to the port, and has made two reports on the state of the river, recommending among other things that the short jetties within the walls should be removed, as, however beneficial they might have been formerly, they now act as obstructions to the free flow of the tide; and that the stones be made use of in building a breakwater along the edge of the North Bull to keep out the sand that is continually washed in by the sea; and that, as soon as funds can be obtained, a more extensive breakwater should be there built in order to afford shelter to vessels in north-easterly gales.

App. B. Ev. p. 236. The Harbour Commissioners, however, at present have no means of undertaking so large a work, their income is entirely mortgaged to the Board of Public Works to pay off the principal and interest of 9,620*l.* which they are in debt for money borrowed to improve the harbour.

The River Boyne has its source in the Bog of Allen, near Carbery, in Kildare, and after receiving several tributaries in a circuitous course of 52 miles, and flowing by Trim, Navan, and Slane, it falls into the sea at four miles below Drogheda. It is navigable for vessels of 300 tons up to the town quay; and by means of artificial deepening and canals effected in 1770, the navigation for barges of 50 tons was extended to Navan, a distance of 19 miles from the town. The tide is felt as far as Oldbridge, two miles and a quarter above Drogheda, where is the first lock gate of a canal constructed in 1778.

The whole descent of the river is 280 feet, or about five feet for a mile of its course; but from Drogheda bridge to the sea, the fall is probably not more than a foot a mile. Including the Blackwater and other tributaries, the Boyne drains an area of 1086 square miles; and, assuming that the average annual fall of rain in Ireland amounts to 36 inches, and that two-thirds of this quantity are evaporated, the river bears every year 1100 million cubic yards of water to the sea. This vast amount of power, if properly guided and confined in its passage, would seem ample to keep a good channel open; in addition to this there is the daily scour of the tide, which is more than double that of the fresh water.

The Boyne navigation Company were incorporated for the purpose of rendering the Boyne navigable from the bridge of Drogheda upwards to Trim. This work was originally contemplated in the General Inland Navigation Act of 1715; (2 Geo. I. c. 12 s. 21.) but in 1787 certain Commissioners were appointed for managing this particular navigation. The company long controlled the trade of the river, but they were found to have no legal right to levy tolls below Carrick-Dexter, near Slane, a distance of about 12¾ miles, and in 1834 they were succeeded in the care of the navigation by the Board of Public Works. The Lower Boyne Navigation yielded 724*l.* as tolls in 1843, and the tonnage upwards and downwards amounted to about 12,000 tons. In general the revenue is sufficient for the purposes of management and of gradual improvement. Nine miles of the work were completed by the Navigation Board and Local Commissioners at an expense of 75,000*l*, and subsequent public grant of 12,500*l.* The work has only been carried as far as the town of Navan.

The third report of the Drainage Commissioners for 1845 states, that the Upper Boyne and Yellow River contain 7059 acres of flooded and injured lands extending along 54 miles of rivers and streams, the estimated expense of draining which is 25,706*l.* The completion of this work would render 24 miles of the Boyne navigable, for flat-bottomed boats of from 10 to 30 tons, from Edenderry nearly to Trim. If the navigation between Trim and Navan, which was at one time commenced and partly executed, were now open, the whole line of the Boyne to Drogheda would be available for the transit of agricultural produce; which, besides benefiting the interior of the country, would greatly increase the traffic of the port.

APPENDIX A.

DROGHEDA. *River Boyne.*

No. 10.

Report of the Examining Commissioner.

NUMBER and TONNAGE of VESSELS belonging to the Port, and of Arrivals and Sailings in 1845:—

—	Belonging to the Port.				Coastways.				British Colonies and Foreign.			
	Under 50 Tons.		50 Tons & upwards.		Inwards.		Outwards		Inwards.		Outwards.	
	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.
Sailing Vessels .	8	219	33	3,595	646	48,460	386	34,396	16	2,998	1	221
Steamers . . .	..	..	5	1,297	124	32,794	287	71,785	..	..	..	..
Total .	8	219	38	4,892	770	81,254	673	106,181	16	2,998	1	221

The Custom duties for 1844 amounted to 9,372*l.* The income of the port arising from 6*d.* a ton on the registered tonnage of all vessels exceeding 15 tons, rents, &c. was 3,500*l.* in 1845; of this sum about one-half was expended in dredging, repairing quay walls, &c., and salaries; the remainder went to pay off the principal and interest of the debt.

The population of Drogheda, by the census of 1841, was 17,363, at present it is about 20,000; of this the seafaring population is about 600. The number of fishermen in the coast district of 58 miles is 1,323, having 245 vessels and boats. There are 53 pilots belonging to the port paid by their earnings, and not by salary; they are appointed by the Commissioners. There is one small ship-building yard, and one patent slip, but no graving dock; also, an extensive foundry on the south side of the river, giving employment to more than 300 persons in the manufacture of steam-engines, boilers, iron bridges, &c. Here are a harbour-master and deputy (one would be ample), and a resident engineer, who has the management of the steam-dredge and of other works on the river. The dredge is of 16-horse power, and capable of raising 400 tons a-day; the soil is deposited at the back of the river walls, but not above high-water mark; it consists chiefly of sand and shingle; the whole expense is said not to exceed 3*d.* a-ton. The length of the quay on the north side of the river is 720 yards, width 27 yards; on the south side, length 107 yards, width 20 yards; they are faced with limestone. There are no cranes on the quays and no mooring-posts, but mooring-rings, which it is alleged are covered at high-water spring tides, and vessels are obliged to cut their hawsers. Five first-class steamers trade constantly to Liverpool.

Drogheda is a bar harbour, with only three feet over it at low-water spring-tides, but with a rise of 12 feet on springs and seven feet on neaps; the current runs from three miles to five miles an hour in freshes. The entrance, which occasionally shifts, is marked by a perch, and by three lights placed only in the year 1842; two of the leading lights are moveable, and are shifted by the light-keeper, on his own responsibility, according to the changes in the bar; but no pilot is specially appointed to sound the bar after each gale, and report its state to him.

A Bill has been brought into Parliament this session for the extension of the Dublin and Drogheda railway to Belfast; this line is intended to cross the river at half a mile below the town bridge, by a viaduct, having a span 250 feet wide and 90 feet high, with five stone piers, averaging 15 feet wide in the stream at high water, and a quay on the north side extending 400 feet below the viaduct. It is to be feared that the piers will be found a great inconvenience to the free navigation of the river, and unless the quay be continued up to join the end of the Custom-house wall, that a large bank will form in the space between and cause shoal water to extend out into the channel.

The chief subjects of complaint at Drogheda are,—that the channel and entrance of the river are not sufficiently beaconed and buoyed; that several large perches are wanted, and a buoy on the North Bull Point; that the Carrick and other banks require to be dredged away; that from want of depth vessels are obliged to lie at some distance from the town quays; that a quantity of stones on the south side have fallen into the river, and the anchorage there is very bad; that the mooring-rings are out of order, and that there is a want of mooring-posts on the quays and at Man-of-war Point; that the river requires to be widened at Grenhills; many of the short jetties to be removed, and the longitudinal walls to be strengthened and completed; that the piers and large buttresses of the bridge cause the water to heap up to three or four feet, and, together with other obstructions above the bridge, prevent the free flow and proper scouring of the tide. App. B. Ev. p.235. App. B. Ev. p. 237.

There is reason to complain, too, that the improvements recommended by Nimmo twenty years ago have not yet been carried out, a great part of which might have been done even with the limited funds at the disposal of the Commissioners, had a systematic course of proceeding been laid down and steadily and vigorously acted upon.

Drogheda affords an additional instance to those already cited in various other ports of Ireland of the ruinous expense of obtaining an Act of Parliament for carrying out a beneficial public measure, the sanction of which by the Legislature would be a matter of course; no less a sum than 2,200*l.*, or more than the whole annual income of the harbour having been expended in legal and Parliamentary expenses attendant upon obtaining the last Harbour Act in 1842.

JOHN WASHINGTON.

[For the remainder of the Reports on Ireland, see p. 93 *a*.]

No. 11.

THE RIVER DEE AND PORT OF CHESTER.

Report of Examining Commissioners.

THE port of Chester comprises the estuary of the river Dee, from the city to its outlet into the Irish Sea, between Helbre Point on the north and Air Point on the south. This estuary was formerly 18 nautic miles long, by five miles wide at its mouth, with an average width of three miles, and contained an area of 45,000 acres.

Immediately without Air Point, and lying across the mouth of the estuary, is the West Hoyle Bank, a vast mass of sand, which dries at low water, and the approaches to the river from the sea are to the eastward and westward of this bank; that on the Cheshire shore, called the Helbre Swatch, having nine feet over its bar; the other, known by the name of Chester Bar, having 12 feet over it, at low water, or rather more depth than in the best entrance to the Mersey, with a similar rise of tide—that is, 30 feet on springs.

Admiralty Chart, 1838.

The two best anchorages are Wild Road and Mostyn Deep, just inside the point of Air on the Welsh coast, and Dawpool Deep, on the Cheshire shore, separated from each other by the Salisbury bank, which dries at low water.

The whole distance from the bar to the city of Chester, is 27 nautic miles; the distance of the chief points, respectively, and the rise of tide at each, is as follows:—

The Bar to Point of Air,	6	miles,	rise of	tide,	29½ feet.
Point of Air to Flint -	10	„	„	„	21½ „
Flint to Connah's Quay,	3⅔	„	„	„	14 „
Connah's Quay to Chester,	7⅓	„	„	„	12 „

App. B., No. 173. At Connah's Quay the estuary now terminates, it having been contracted, from hence to Chester, into an artificial tidal canal, about 170 yards in breadth at the surface; its navigable breadth, however, is reduced to 80 yards, by means of a series of rubble-stone groynes, or jetties, projected at right angles from the south-western bank. The harbour of Chester consists of a reach or bend of the upper part of this canal, opposite the town, and is about 300 yards long by 70 wide.

The Dee, the principal river of Cheshire, has its source in Lake Bala, in North Wales, and flowing in a general north-westerly direction, and receiving in its course several tributary streams, it reaches Chester after a distance of about 60 miles. This river, like all other mountain streams, is liable to frequent and sudden freshes, which are of great benefit in scouring its channel; but owing to the causeway at Chester Mills, which prevents the free escape of the waters, they occasionally flood the neighbouring country and do much damage. Weirs have been erected on the river at various places; but the worst and most prejudicial is that immediately above the city bridge, which rises 11½ feet above the bed of the river, and entirely arrests the upward flow of the tide, except at very high springs, when the water rises 3 feet over it, and the tide is felt at Pulford Brook, seven miles above the city, or perhaps farther.

Ormerod's Hist. of Cheshire, I., xlvii.

We learn from the History of Cheshire, that this dam or causeway was erected by Hugh Lupus, Earl of Chester, before the Conquest, in order to maintain a head of water for the Chester Mills; in the reign of Edward the Sixth, Edmund Gamul expended 4,000*l.* in repairs of the dam, a considerable sum of money at that early period. In the 17th century "this causeway became a subject of much litigation, in consequence of its supposed prejudicial effects on the river, by its preventing the free access and discharge of the tidal and upland waters, and thus preventing them from cleansing and scouring the harbours from the accumulating sands." It does not appear whether the weir was reduced in height or not in consequence of the above law-suit; thus much is certain, that a weir still exists, and acts as an almost insuperable barrier to the free scour of the tide.

Holme Papers in Harl. MSS. 2084, 157.

The above brief notice is instructive, as serving to illustrate the correct views taken by some parties at that early period of the damage done to our rivers and harbours by weirs and similar obstructions. The more recent instances of hundreds of tons of stone having been thrown down at the foot of the bridges at Stockton, Wexford, and elsewhere, to secure the foundations; the rubble-stone groynes, or jetties, run out half across the narrow channels of some of our navigable rivers; and the opposition made to the removal of weirs by the trustees of some of our more important navigations, prove that we have made no great advance in juster views on these subjects even in the middle of the nineteenth century.

The peculiar advantages of the position of Chester, at the head of an extensive estuary, on the west coast of England, immediately opposite to the Isle of Man, and to the centre of Ireland, and with a great rise of tide, made it a commercial station of importance in the earliest periods of British history; it eventually became the capital of this part of the kingdom, and occasionally a royal residence. As the Lupus dam, however, silently but surely wrought its mischief, and probably also as vessels increased in size, it was found necessary in the middle of the 15th century, to construct a quay at Shotwick, about five miles below the city on the Cheshire shore, where large ships discharged their cargoes. In the reign of Elizabeth, about a century later, a new quay was built, five miles lower down, at Parkgate, which then became, and long remained, the principal port for mail communication with Ireland.

Ormerod, I. xlvii.

The inconvenience arising to a commercial town from having its chief shipping quay at ten miles distance induced the citizens of Chester to consider if the navigation might not be restored; and among others, Andrew Yarranton, in his quaint book on "England's Improvement by Sea and Land," in 1674, took a survey of the Dee and its estuary, and gave it as his opinion, that a large tract of valuable land might be gained from the sea, and the ancient

Yarranton, p. 191.

navigation restored to the quays at Chester. Twenty-six years later, in 1700, an Act was obtained "to enable the Mayor and Citizens of Chester (the legitimate conservators of their river) to recover and preserve the navigation of the river Dee," for which certain dues were granted for 21 years. It appears that although considerable sums of money were expended under this Act, its object was not attained when the term expired.

About the year 1732, therefore, a joint-stock company was formed, and in 1740, was incorporated by the style and title of "The Company of Proprietors of the Undertaking for recovering and preserving the Navigation of the River Dee." The preamble to the Act of 1732, recites that of the Act of 1700, which repeatedly states that the object of the Act is the rendering and maintaining the river navigable to Chester; and as a means of accomplishing this end, and as an encouragement to the undertaking thereof, permission is given to enclose the sands called the White Sands, not bearing grass, lying between Chester and the sea. "And whereas the making the said river navigable will be a means to advance the trade of the said city, and great benefit will accrue thereby to the inhabitants thereof, and to the towns and countries adjacent or near the said river, as also be a means to increase the number of seamen and watermen, and promote the public good of this kingdom;" it was enacted that Nathaniel Kinderley, his heirs and assigns, shall have full power and authority, "to make and keep the said river Dee navigable from the sea to a certain point within the liberties of the city of Chester, called Wilcox Point, in such manner that there shall be sixteen foot water in every part of the said river, at a moderate spring tide, for ships and vessels to come and go to and from the said city; *and to that end*, to alter, direct, and make the channel of the said river to run through such part of the said White Sands as the said Nathaniel Kinderley, &c., shall think fit."

11 and 12 Will. III.
6 Geo. II. c. 30.
6 Geo. II. c. 30.

Now, unquestionably, the meaning of the Act of Parliament was that a channel, navigable at all ordinary spring tides, should be made and maintained up to Chester Quay; not that on one tide only in a fortnight a vessel should carry this depth up, but for the three or four days over which spring tides spread; and certainly this seems little enough for a place dignified by the name of a port. And in order to provide funds to accomplish this object, permission was given to embank the White Sands, with the proviso that the property was to become liable in case of the required depth of channel not being maintained. And as a test of the required depth, and as a penalty for not maintaining it, it was enacted, that if laden vessels, drawing 14 feet water, at a moderate spring tide, cannot pass safely down the river, the Commissioners may order a convenient wet dock or basin to be made, fit to hold twenty ships. By the 11th clause, 313 Commissioners, selected out of the neighbouring landed proprietors and citizens of Chester, were named to arbitrate claims, and to see that the Dee Company fulfilled their engagements; and in 1791 it was enacted that the qualification of a Commissioner should be that he possessed land of the value of 200*l.* a-year in Cheshire, Flintshire, or the city of Chester.

6 Geo. II. c. 30.
6 Geo. II. c. 30, s. 6.
6 Geo. II. c. 30. s. 11.
31 Geo. III. c. 88, s. 3.

The 47th clause directs that, in case of any dispute, "the Act shall be construed most beneficially, for making the said river navigable, and in preserving and continuing the navigation thereof for ever, according to the true intent and meaning of this Act." And this is repeated in subsequent Acts. In April, 1737, it appears the river was turned into its new channel, and in the following year the standard was fixed.

6 Geo. II. c. 30. s. 47.
17 Geo. II. c. 28.
14 Geo. II. c. 8.

In 1743 the standard depth was reduced from 16 to 15 feet, and the city of Chester and the Dee Company were directed each to appoint a supervisor, who were to sound the river from time to time as required, on three successive tides, in order to ascertain the depth, and books of the soundings were to be kept by the supervisors for public inspection. Thus, it will be observed, substituting a system of sounding, open to great abuse, for the proper and only real test of a navigable river, namely, that of a laden vessel passing safely down it, which had been directed by the original Act of 1732.

17 Geo. II. c. 28, s. 16, 17.

The city of Chester neglected to appoint a supervisor till the year 1800; they thus incurred the penalty named in the 25th section, and thus also omitted to avail themselves of the best check over the proceedings of the Dee Company, vested in them by the Legislature.

17 Geo. II. c. 28, s. 25.

The 18th and 19th clauses of the Act impose penalties on the Company for not keeping the river clear according to the standard. By the 18th section, if for the space of four calendar months, after proper notice of the want of depth has been given by the supervisor, the Company suffer the river to continue silted or choked up, so that *during any part of that time* there shall not be 15 feet water in the channel of every part of the said river, from the sea to Wilcox Point, for ships and vessels to come and go to and from the said city; in that case the tonnage dues shall cease immediately after the expiration of the said term of four months.

17 Geo. II. c. 28, s. 18.

This penalty has been enforced, or rather immediately after Mr. C. Dundas's remonstrance as to the bad state of the river in 1819, on proceedings being about to be taken by the citizens of Chester, the payment of dues was relinquished.

By the 19th section, in case the Company shall for the space of eight calendar months next after the expiration of the said term of four months, suffer the said river to continue silted and choked up, so that *during any part of that time* there shall not be 15 feet water in the channel of every part of the said river, &c., in that case immediately after the expiration of the said term of eight months, the Commissioners are authorized to take possession of the property of the Company, and apply it to the regaining of the said depth.

17 Geo. II. c. 28, s. 19.

The 22nd section enacts that two additional standard piles shall be erected by the supervisors, and for ever after be maintained and kept in repair at the cost of the Dee Company.

17 Geo. II. c. 28. s. 22.

In virtue of these Acts of Parliament the Dee Company proceeded to embank successive portions of the White Sands. These embankments extend about six miles below Chester, and, according to the Company's own plan, appear to comprise about 5000 acres of land, now in a high state of cultivation. At the same time the proprietors on the Flintshire shore have em-

28 Edw. I.

banked upwards of 3000 acres, making a total of 8000 acres, out of the 12,000 acres of the estuary originally contained above a line joining Kelsterton and Burton Head. Besides the above, portions have been embanked near Wepre Gutter and elsewhere, which inclosures, as they are not authorized by the Acts of Parliament, it is presumed would, if examined into, be found to belong to the Crown, or to the Corporation of Chester, as grantees of the Crown.

We have now to inquire whether the Acts of Parliament that sanctioned this extraordinary encroachment on the waters of the estuary have been complied with. Have the letter and the spirit of the Acts, which transferred the rights of the citizens of Chester (as conservators of their own river) to a Joint Stock Company, been carried out? Has the original standard, and have the two additional standard piles, as specially directed by the Act, been erected and maintained? Has the statutable depth of water, namely, 15 feet at moderate spring tides up to the quays of Chester, been obtained and preserved? Have the works, apparently, been carried out with a view to make the best navigable channel?

And here it may be as well at once to disclaim the supposition that *all* embankment of land overflowed by the sea must be wrong. The strict preservation of such tidal lands would be right as a general but not as an universal principle; several instances might be mentioned in which marshes, sands, &c., have been enclosed without damage to navigation; it is the injudicious and indiscriminate embankment, and the great and unnecessary exclusion of tidal water that cause the mischief. An area of a few acres, if properly selected at the upper part of an estuary or harbour, and deepened as a tidal reservoir, may, in many cases, be rendered of as much benefit as a large surface of waste sand only covered at a high water of spring tides. Embankments, however, and especially where a bar complicates the case, must be dealt with very cautiously, and after a careful study of the locality, and of the origin and nature of the sands; but if due precaution be used there is little doubt but that a certain amount of such sands may generally be enclosed with advantage to navigation.

1st. With reference to the standard. This appears to have stood originally on the bottom or apron of the ten-gate sluice (the zero being nine feet above this point); and when that sluice, built for a particular purpose, became useless and was taken down, the standard must have been removed with it. A new standard was set up by the Dee Company's supervisor in 1801, but it was not admitted as correct by the Commissioners. The standard piles, intended to serve as a check to the above, were never erected.

17 Geo. II. c. 28, s. 22.

App. B. Ev. p. 293.

Some mystery, which it is not easy to understand, seems to hang over the question of the Standard. By the Act of Parliament the supervisors, at the costs and charge of the Dee Company, were enjoined to set up two or more piles of timber, or of other durable material, having their tops or surface on a level with 9 feet on the Standard; this they neglected to do, and by further neglect, the single original standard was allowed to perish. The River Dee Company's agent states that he did all in his power to restore this level; but surely, if there were any desire to accomplish it, there could be no great difficulty in doing so.

App. B. No. 296.

App. B. No. 295.

From a long series of observations it is well known that an average spring tide rises to 18 feet 3 inches on the Liverpool Dock-gates; now the comparison of a few weeks' careful observations made at both places at high water, when there are no freshes in the river, would give the level quite near enough for any practical purpose. Judging from a few observations recently made, there seems reason to believe that the present standard mark of 9 feet is about 1 foot 6 inches, if not more, above its proper height. If, therefore, this level has been used as the standard by which to judge of the depth of the river, it would have made the depth appear 18 inches better than it really is, or, in other words, there should be a depth of 15 feet in all parts of the river whenever the tide reaches the 7 feet 6 inches mark on the standard. A comparison with Holden's tide tables is occasionally equally fallacious, as in south-west and north-west winds they are often from a foot to 18 inches in error, showing less than the actual rise, as on the 9th April and 19th July 1845.

See Plan, p. 318.

2ndly. With respect to depth of water. Here it is necessary to allude to what was the state of the river by the earliest record we have, namely, the plan by Greenvile Collins, made about the year 1685; this plan marks 15 feet over Chester Bar in the north channel between the Middle Patch and the Hoyle Sand; it shows the anchorages both in Wild Road and Dawpool Deep; and, in addition, a straight wide channel extends up to Burton Head, off which was six feet depth at low water; at the anchorage in mid-channel off Parkgate, there are 15 feet marked at low-water spring tides, where there is now a sand high and dry.

App. B. No. 181

App. B. No. 181.

The depth shown off Burton Head is corroborated by the testimony of Adams, who stated in 1799 that he had, when a youth, been on board a vessel lying afloat at low water, and moored to a stone called Coffin's Stone, on the Chester side of Burton Head, in a place now confirmed marsh land, and where, instead of there being six feet depth at low water, it requires a 14 feet spring tide to cover the surface of the marsh, thus showing above 20 feet rise of soil: and the agent to the Dee Company states, with much frankness, "that the whole surface of the estuary has probably proportionably risen."

See Plan, p. 318.

Now, when we remember that the embankments erected by the Dee Company and others have enclosed more than 8000 acres of the estuary, and that taking the mean of spring and neap tides, there was at least an average depth of six feet over this space at high water on each tide, amounting to 80 millions of cubic yards, the whole of which is now excluded, it is difficult to conceive that this enormous loss of scouring power has not already affected the depth over the bar, or that it will not affect it, for it must be remembered that this process of making land is still going on, although the Dee Company may, for a time, have ceased to embank.

App. B. Ev. p. 293.

Another cause of injury to the river was the abstraction of the Dee waters to feed the

APPENDIX A.

CHESTER.
River Dee.

No. 11.
Report of the Examining Commissioners.

Cheshire and Ellesmere Canal, which runs into the Mersey at Ellesmere Port; this took place in 1804, and to this, it appears, the Dee Company were consenting parties. They were to be indemnified for any damage done to the trade of the river by the Canal Company guaranteeing 235*l*. a-year, being the average amount of the tonnage duties received by the Dee Company; but this pledge was never exacted. No indemnity for loss of scouring power seems to have been thought of, nor indeed could any be given, for who could measure the amount of mischief caused by this diversion of the water and of the freshes of the river? We may observe, that it seems a singular arrangement that the same individual should have been solicitor to both the River Dee and the Canal Company, and a proprietor in both, and at the same time should have been clerk to the River Dee Commissioners.

For the first sixty years, as nothing is said to the contrary, we must suppose the river wi [illegible] good order. It appears in evidence, that about the year 1800, Mr. Dixon, a merchant, complained of the state of the river. In 1819 it was so bad that Mr. Dundas, afterwards Lord Ameshury, one of the Commissioners, interfered, and rather than contest the point, the Dee Company saw fit to give up the tonnage dues, as above mentioned, which they had levied since the year 1738, and which, it was stated, had amounted to about 17,000*l*. App. B. Ev. p. 293.

Sir John Rennie, who surveyed the river in 1837, says, "The navigation between Flint and Chester cannot be termed fit for vessels drawing above 13 feet at spring tides, and then they are subject to considerable detention during the period of neaps." Again he says, "With the exception of 4 or 5 vessels of 250 tons burthen, belonging to the Cheese Company, who have a steamer to tow them up and down the river during spring tides, all the trade of Chester is transported in small craft of about 70 tons burthen." Again, "Vessels drawing only 12 and 13 feet can scarcely reach Chester now at spring tides, and then only with considerable care and attention." App. B. No. 168.

In 1839, Messrs. Stevenson of Edinburgh, at the desire of the inhabitants of Chester, made a survey of the upper part of the river with a view to its improvement, including a series of tidal observations and levels; the result of their examination was "that the navigable track to Chester had in some places little more than 13 feet at high water of ordinary spring tides, and therefore could not be said to afford an available depth to shipping of more than 12 feet at high water." App. B. No. 173.

In the course of the inquiry at Chester, Captain Rowlands stated, "that he had known the port of Chester for 50 years: the river was better then than it is now; he could then beat cheese brigs up to Connah's Quay with moderate spring tides; he cannot do so now. Has known great quantities of ballast thrown into the river; the river is not 50 yards wide at Chester Quay; it is narrowed from the accumulation of silt." App. B. Ev. p. 294.

Captain Curtis, an intelligent seaman, who has been acquainted with the river for 19 years, says in evidence, "My vessel draws from 12 to 13 feet; last December I was obliged to take 140 tons out of her, on a 17-feet spring tide, and then could not come up to Chester, although drawing only 8½ feet water. The Dee Company have been constantly at work throwing stones into the channel of the river, said to be for the purpose of preserving the Cops; the channel is not fit for the purposes of navigation; my ship is only 72 feet on the keel, and I cannot drop her up or down with safety; I know no river so bad as Chester river; I have known several vessels refuse freights for Chester river; if I were not in the cheese trade I would refuse them too, because I consider it not a safe river; I have known vessels to get on the groynes. There is a large trade in the river, and it would be greatly increased if there were sufficient water and the navigation were otherwise improved. We want lights and beacons in the river; if the river were properly buoyed and lighted, I would rather come over Chester bar than over Liverpool bar; the present buoys are too small, we want a light-ship and also a better adjustment of the Point of Air Light; the pilots complain of this light, but they get no redress." App. B. Ev. p. 295.

Captain Evans, also master of a vessel, who has been at sea several years, and is now agent to the Shipping Association, says, "that five years ago there were 4 feet more water in the river than now; the bridge now erecting by the Holyhead Railway Company is an obstacle to the tidal scour, and will prevent any navigation, except by flats and lighters up to the Dee Mills; the reason why there was no trade was because there was no river; if the river was in a good state, the vessels carrying ore, &c., would prefer coming to Chester, as they would then get back freights of coal." App. B. Ev. p. 296. Captain Evans, on being asked to be more precise in his statements respecting the state of the river, submitted the following list of casualties:—"27 December, 1844; the *Trader*, drawing 9 feet 3 inches in a tide of 16½ feet (at Liverpool) grounded 200 yards below the Sluice-house; wind easterly. 12th March, 1845; tide by table, 17 feet 5 inches; *Trader*, drawing 8 feet, could not start. 25th May; tide by table 18 feet 6 inches; *Trader*, drawing 10 feet 1 inch, grounded; took 14 tons out, and got her off in the night's tide. 5th June; tide by table 15 feet 4 inches, the *Glynne*, drawing 9 feet, grounded. On the 6th, still aground. On the 7th, tide 15 feet 6 inches, got *Glynne* off and up to the crane. 14th January, 1846, tide 17 feet, the *Cheshire Lass*, drawing 11 feet 2 inches, left the Sluice-house and got down the river; the remainder of her cargo was sent down in a steamer, part taken on board at Connah's Quay and part in Wild Road; the pilot restricted her to 11 feet draft of water." App. B. No. 295.

The last evidence it is necessary to cite on the state of the river is contained in the Dee Company's own supervisor's report made to the River Dee Commissioners at their meeting held at Chester, on Tuesday the 5th August, 1845. From this it appears that from the 1st June, 1844, to the 9th April, 1845, the river had never on any occasion been of the statutable depth; and that, in the months of October and April during this period, the soundings showed as much as 4 feet below the Standard. App. B. No. 294.

And here we would guard against its being supposed for a moment that we admit any such evidence as to the depth of a navigable river, as that of a house carpenter, dignified with the name of the River Dee Company's supervisor. The only true standard of depth for a navigable river is the draft of water of a vessel that can freely pass up or down; and it is notorious that no pilot on the Dee will take charge of any vessel drawing more than 11 feet of water.

Further proof would seem to be unnecessary. Why the River Dee Commissioners have not proceeded against the River Dee Company's estates in terms of the Act, and in virtue of the Oath they have taken, "truly and impartially to execute and perform all and every the powers and authorities as Commissioners appointed in pursuance of the Act," it does not fall within our province to inquire.

17 Geo. II. c. 28, s. 19.
6 Geo. II. c. 30, s. 32.
3rdly. We have now to consider the steps taken by the Dee Company, in terms of the Act, "to recover and preserve the navigation of the Dee." It has been shown in the chart by Greenvile Collins, made in 1684, that a funnel-shaped deep-water channel extended past Parkgate and Burton Head, above which, even at the lowest spring tides, there were six feet of water; beyond this point the channel is represented in a natural sweep, running along the Cheshire shore, till thrown off (on the ebb) by Blecon Point, when it diverges towards the opposite bank, thus showing that the lowest level of the estuary was along the Cheshire coast; and that, at a place only six miles below Chester vessels lay afloat in six feet water at the lowest spring-tides; from the testimony of Adams, before alluded to, the same was the case as late as 1732.

17 Geo. II. c. 28.
In that year the Dee Company obtained their Act, and in the month of April, 1737, the river was turned into the new cut; this artificial canal, by a series of straight lines, forces the course of the stream, immediately after passing the Cheese House, at an acute angle towards the south-west; and then, abruptly turning again to the north-west, carries it along the Flintshire shore in a direct line for six miles, to Connah's Quay, between parallel banks, in which the navigable and tidal channel is contracted to 80 yards in width, by a series of rubble-stone groynes or jetties, projected from the south-western side; on escaping from between these walls, the river divides into two channels, and makes a sweep of two miles to the eastward, returning to the shore at the town of Flint.

See Plan, p. 318.
6 Geo. II. c. 30.
One mile below Flint the stream again abruptly branches off across the estuary, and joins its original natural channel at two miles below Parkgate, or 14 miles below Chester, where for the first time it attains a depth of six feet at low water. Thus the mariner that in 1732 moored his vessel afloat and in safety six miles below Chester, cannot in 1845 place his ship in like security nearer than 14 miles to that city:—and this in execution of an Act "for recovering and preserving the navigation of the Dee as a means to increase the number of seamen and watermen, and to promote the public good of the kingdom."

App B. No 168.
From this nautical view of the question, let us turn to the opinion of engineers. Sir John Rennie in 1837 says, "At Parkgate, where there were used to be 18 feet at low water, there is now an extensive shoal, reaching almost across the estuary at low water, so that it is unfit for vessels or boats of the smallest class; whereas, formerly it used to be one of the principal stations for the packets between England and Ireland. One of the chief causes of this was no doubt the diversion of the channel from its natural course from the Cheshire to the Flintshire shore. Had the channel been continued there, and proper means been taken, the depth at Parkgate would have increased rather than have diminished. The Company must have had some reason, which does not appear, for adopting this course. It is quite clear, however, that as far as the river is concerned, the measure was not quite so complete as it might have been; for not only is the course lengthened nearly five miles, but four most inconvenient angles or bends are produced, which add materially to the friction and consequent impediment of the scour of the waters, both tidal and fresh." Again, he adds, "but the navigation is still far from being what it ought to be, or is capable of being made." And further on, as a specimen of the mode in which the tidal water has been excluded by the embankments in question, Sir John Rennie gives the following sectional areas:—

At King's Ferry, half-way along the artificial canal . .	5,800 feet.
Just below the rubble embankment in the natural channel	82,800 feet.

App. B. No. 173.
The Messrs. Stevenson, in 1839, say, in their Report, "The upper part of the river from the end of the Stone causeway to Chester is, nearly throughout its whole extent, in a bad condition. In the construction of the artificial canal, it is to be regretted that several sharp and unnatural turns have been introduced. The curve at the Cheese-house near Chester is very objectionable. At the two turns immediately below, at which places the want of depth is more immediately complained of, the formation of banks and shallows may, in a great measure, be prevented by the removal of the groynes and the substitution of continuous face walls. At Connah's Quay, the river has been forced into an unnatural course by the erection of jetties and other means."

Again, in a Report dated 1846, Mr. D. Stevenson repeats his opinion, "that the means taken by the River Dee Company to carry out the provisions of their Act were in many respects injudicious; and judging from the unnecessarily abrupt and objectionable turns which were given to the new channel laid out by them, there is reason to fear that in all their operations, the reclaiming of land was more prominently kept in view than the improvement of the navigation."

1st Report, Q. 1759,
1st Report, Q. 1687.
In his examination before this Commission, Mr. D. Stevenson re-asserts his statement, "that the embankment is extended on a line the most injudiciously laid out with regard to navigation;" and he states as an illustration of the throttling effect of the narrow entrance of the canal on the tidal flow, that at a certain time of flood on spring tides, the water stands 8 feet higher at Flint than at Chester, and (if the expression may be allowed) actually slopes up hill; since the fall of the ground is fully 10 feet in the opposite direction, that is from Chester to Flint.

APPENDIX A.

CHESTER.

River Dee.

No. 11.

Report of the Examining Commissioners.

We have hitherto purposely refrained from quoting any opinion of engineers who have been employed by the Dee Company, preferring to show the present state of the river from independent sources, and more especially so since the only answer that has yet been given to the complaints of neglect has been met by the Agent to the Dee Company, with the assertion "that in all that had been done with respect to the river, Mr. Telford had been consulted, and all that he had advised had been carried out." Now it appears from his Reports transmitted to this Commission by the River Dee Company, and printed in the Appendix, that Telford was first consulted in 1817; at this time the parallel walls had long been made as far as Connah's Quay, and four-fifths of the whole land had been embanked. Telford, therefore, had nothing to do with the proceedings up to this time. App. B. Ev. p. 295.

In 1817, Telford reported that certain shoals, which he enumerates, ought to be removed. App. B. No. 167.
In 1819, he advised "to cut away the point of the rock on the shore immediately below Connah's Quay, so as to give the low-water channel a straight direction from the said quay downwards." App. B. No. 167.

On the 1st Sept., 1820, in consequence of the state of the river, the Dee Commissioners put the following pointed queries to him:—

1st. Whether, if the channel of the river could be confined in a straight line from the end of the present causeway to the Lamp Rock (near Flint), it would not have the effect of deepening and scouring the channel from the Lamp Rock to Chester?

2nd. Whether it is practicable to do this, and by what means, and whether any alteration of this kind would affect the outlet of the river from the Lamp Rock to the sea?

3rd. Whether he can suggest any other preferable plan for improving the navigation of the river? App. B. No. 167.

On the 30th April, 1821, Telford replied,—" 1st: I am of opinion that, if the river channel had a straight direction from near Connah's Quay to a moderate distance without the point to the Lamp Rock, and also without the rock upon which the town of Flint is situated, the effect would be to scour and preserve the channel between Connah's Quay and Chester in a more effectual manner. 2ndly. I am opinion that a sufficiently straight channel such as I have described may be obtained by cautiously pursuing the same mode by which the channel of the river has already been changed from its previously crooked course into one about a mile nearer to the Flint shore. This measure having been perfectly successful, I do not hesitate to recommend that it be extended of the same materials, and by similar caution and progressive steps, in order to direct and aid the current of water in cutting away the sand-bank on its western side, which it is now evidently doing, and so by degrees to get the whole channel into the desired direction. If what is here recommended be accomplished, as far as opposite to Flint, the effect would not be unfavourable on the outlet of the river, because a straight direction for the flux and reflux of the great body of the tide is better than a crooked one. But it is not to be forgotten that as the sand and mud accumulate, and marsh lands are formed in the upper part of the estuary, the power of scouring the lower portion is diminished."

The Dee Commissioners thereupon directed that a copy of the above Report should be transmitted to the Committee of the River Dee Company, and that they be required to carry the plan suggested by Mr. Telford, for the improvement of the channel of the River Dee, into execution with as great expedition as the nature of the work would admit of. App. B. No. 167.

This distinct and deliberate opinion of Telford, as to the best means of improving the river, is concurred in by the Stevensons, in their Report in 1839, who show that while the fall in the bed of the river between Chester and the end of the causeway is only five inches per mile, the fall from this latter point to Flint is no less than 24 inches per mile; if, therefore, the stream in this part were directed and confined, it must operate beneficially on the bed of the river and reduce it to a uniform slope; and it is further confirmed by Mr. Provis, the Dee Company's own engineer, who says "there does not exist a doubt that this continuation of Mr. Telford's causeway, and the formation of the new channel, would essentially improve the river. How, then, can the Dee Company's agent venture to assert "that all Mr. Telford had advised, had been carried out," when this, the chief work of all, recommended by him and by subsequent engineers, has not been begun? App. B. No. 175.

Prior to this period, Telford had directed an extension of the old rubble-stone causeway, which reached as far as opposite the Boot Rock, just below Connah's Quay; but it stopped short $2\frac{1}{4}$ miles above Flint; in his subsequent Report, he does not recommend its being continued; and in a former Report, in 1817, he says, to extend it below Boot Rock would be ineffectual. How to reconcile this fact with his explicit reply to the Dee Commissioners is not an easy task in the absence of all knowledge of the written or verbal instructions that he received. The impression derived from reading his Reports is that, had he not been limited in point of expense, he would have urged on such a work; and his comparison of the River Dee with the Clyde in his last Report in 1828, confirms this view of the case. After pointing out the resemblance between the two rivers in navigable length, dimensions, and shape of estuary, he adds "the Clyde has not yet been rendered as perfect as the Dee, but similar means are still employed to render it so." Yes; and those means having been continued, the Clyde, with a far inferior rise of tide to the Dee, now offers a depth of 17 feet, and occasionally of 19 feet at Glasgow Quay. And all the engineers above cited, to which we may add Mr. Scott Russell, agree in the opinion that there is no reason, if it were desired and proper means were used, why Chester should not have the same. App. B., No. 167.

It now becomes our duty to consider what the port of Chester may become. This is a subject in which the citizens of Chester, the River Dee Company, the proprietors along the banks of the estuary, and the towns along the Welsh shore can all meet on common ground, all are interested in improvement, and all should unite in an enterprize conducive to the common welfare of all. The trade of this port, from its position in a highly cultivated and populous country, and from the numerous railway communications that are now being formed in its

Appendix A.

Chester.
River Dee.

No. 11.
Report of the Examining Commissioners.

neighbourhood, must, if it meet with only fair encouragement, rapidly increase. Chester possesses every facility and advantage for the ready and economical construction of quays and wet docks, in the flat nature of its shores, and a great rise and fall of tide. The Customs returns show that trade is already on the increase. The duties in 1844 were 76,010*l.*; in 1845, 88,439*l.* Several vessels have been built at Chester within the last few years, and among them one of 600 tons. The mining districts of Flintshire will shortly be connected by railroad with the various shipping places along the coast: a large and increasing trade in coals already exists at Flint. The Hawarden Iron Works Company are now engaged at Sandycroft, four miles below Chester, in executing some heavy works for the Admiralty, being the engines for the "Fury" steam frigate; this vessel, however, is obliged to go to a neighbouring port to take them in, yet, not on account of any natural obstacle, for Chester, with an equal rise of tide, can boast of one foot more water over her bar than Liverpool.

To turn these advantages to account, all parties should unite in one well-considered plan of improvement; the old statutable depth of 15 feet is quite out of date; every effort should be made to get a depth of 18 or 20 feet up to Chester quays. We have now an excellent Admiralty chart of the entrances of the Dee, and the lower part of the estuary up to Flint, made by Captain Denham, R.N., which clearly indicates all the deep-water channels which have since been buoyed out by the Trinity Board, who have also erected a Lighthouse at the Point of Air. The upper part of the navigation has been thoroughly surveyed by the Messrs. Stevenson, who have given in a plan for its improvement; and without offering an opinion on their's, or on any other plan, doubtless some efficient plan can be formed for the improvement of the river. It will probably be found an advantage to lead the channel below Flint by an easy curve into the deep water of Mostyn Deep, and thus, by shortening the passage, enable vessels to come up to Chester in one tide.

One great barrier to improvement, however, is the dam or causeway at Chester Mills; and it is earnestly to be hoped, if this cannot be removed altogether, that at least it may be reduced some feet, and thus not only benefit the navigation below, but materially improve the uplands, which are liable to be flooded in all heavy freshes, and thereby receive much damage. Were this dam removed, a single heavy fresh from Bala Pool might effectually scour out a deep channel; and were the stream confined as far as the deep water below Flint, the sand would not be heaped up as it now is below Connah's Quay, nor would there be the fear of its being brought back as is now the case by the returning tide.

One other point to be attended to, would be the establishment of an efficient body of pilots off Chester Bar, at the entrance to the river, which is far from being the case at present; indeed the evidence shows that many of the pilots appointed under the Point of Air Trustees have
App. B. Ev. p. 294. hitherto passed no examination, and there are many and well-grounded complaints of their extreme incompetency.

Perhaps it is hardly necessary to mention, that four projects for crossing the estuary of the Dee by different Railroad Companies have been brought forward during this Session of Parliament; one of them boldly proposing to cross from Flint to Parkgate, at 14 miles below Chester. On these attempts being made public, the citizens of Chester proved themselves the true conservators of their river, and forthwith engaged the services of an eminent engineer to examine into the several schemes; his masterly Report at once defeated the projects, and until the facts contained in that Report are disproved, no impartial tribunal can ever again lend its countenance to similar attempts.

As before remarked, one great use to be made of this case is as a warning for the future, and particularly so at this moment, when there are attempts being made in every direction to place bridges across our navigable rivers; when the permanent interests of the country, and our nurseries for seamen, instead of being carefully guarded and cherished, are being sacrificed to the present mania for rapid railroad travelling, for saving a few minutes in a distance of a 100 miles. We have already alluded to the four schemes proposed for crossing the Dee; we may also point to a railway recklessly carried along a part of the sea coast of Devonshire, cutting off all free communication with the sea; to a daring attempt recently made to cross the sands of Morecambe Bay, and to an equally bold scheme now in agitation, to enclose some 40,000 acres of the Norfolk estuary of the Wash, in utter contempt of the wants, the rights, and the interests of sailors and of the public.

The case in question affords additional proof, that none but independent Government controul is sufficient to check similar transactions in future. The Legislature did its utmost to protect the interests of the port by placing the Mayor, Recorder, and Aldermen of Chester as Commissioners, to keep a watchful eye over the proceedings of the Dee Company. If men holding such situations would not look after the interests of their own port and city, even after being specially appointed by Parliament to do so, and given the power to redress themselves, where can we look for guardians of our ports? No simply local conservancy would seem to be sufficient; family connexion, social relations, the desire to live in peace with one's neighbour, all militate against such men doing their duty. Some higher power entirely independent of local connexion or bias must be added to the local ruling authority, or there seems little hope of success; and even that higher power should not be left to itself, but should be obliged annually to lay before Parliament an account of its stewardship, in order that it may circulate through the public press of the country; no other species of controul is to be trusted.

John Washington.
Richard Godson.

Appendix A.

Great Yarmouth.

No. 12.

No. 12.

PORT AND HAVEN OF GREAT YARMOUTH.

Mr. Hume's Report.

Report of the Examining Commissioner.

Before stating the conclusions that appear deducible from the evidence collected in Norfolk, I beg to state the course taken to collect it.

App. B. Nos. 252, 253.

A letter was sent from the Tidal Harbour Board to the Secretary of the Harbour Trust, and to the chief magistrate of the town, intimating that the Commissioners would visit the harbour on a day appointed, and there, in open court, would inquire into the past and present state of the harbour, and would be ready, after examination of the officers of the harbour, to take the evidence of all persons capable of giving information on the subject. Public notice was given in the newspapers of the district, eight days before the meeting, requesting all persons interested in the inquiry, and who were competent to give information on the subject, to attend.

That course was adopted at each place visited, and the interest excited was sufficient to bring to the meeting persons of all classes able and willing to afford information.

By the inquiry thus made in open court, generally in the town-hall, more correct and more satisfactory information was obtained in a short time than could have been obtained by any other mode of inquiry.

Publicity in the proceedings respecting harbour and other trusts is so important, that I recommend all proceedings of the kind to be held in open court, where the public can attend if they please.

The intervention also of a public officer deputed from the Board of Conservancy to any harbour or place, to inspect and publicly to inquire into the proceedings of the local Board, must at all times have a good result.

After inspecting the haven throughout at different times, accompanied by the persons best qualified to afford correct information on the spot, public meetings were held in the town-hall of Yarmouth on the 21st of October and 6th of November, 1845. Returns were also called for from the public officers of the Harbour Trust, and from the Custom-house, to complete the information required.

App. B. Ev. p. 472.

I shall best discharge my duty by referring for details to the evidence taken on these occasions, and to the various Reports and documents which are annexed to this Report, and by confining myself to general observations on particular subjects, arising out of the information obtained, that deserve more particular notice.

App. B. Ev. p. 473.

App. B. Ev. p. 472.

The port of Yarmouth, situated on the easternmost part of the Norfolk coast, is of importance for its commerce and for its fisheries, and its roads are the greatest thoroughfare and shelter for shipping on any part of the coast, having at times from 1500 to 2000 sail of vessels at anchor there. There are generally eight feet on the bar at low-water, and vessels of 13 or 14 feet draft of water come in at ordinary high tide; vessels drawing 15 feet have at times entered the port.

See Plan, p. 506.

The depth of water at the bar has varied greatly at different times; and since Capt. Smyth, R.N., has been pier-master, it has been deepened nearly two feet. The harbour extends nearly two miles and a half from its entrance northward to the bridge, and varies in depth as seen in the map, from 9 to 19 feet, at low water.

The depth of the harbour has also been generally increased three or four feet during the last nine years by dredging, and it appear to be still capable of much greater improvement.

The inequalities in the bottom of the harbour channel, from the Brush to the bridge, have been nearly all removed by Captain Smyth; and, if the width between the piers at the entrance of the haven and at the bridge was increased more in proportion with the breadth of the harbour generally (which is from 200 to 300 feet), the flow of the flood and ebb would be more effectual in keeping the harbour and bar clear. Captain Smyth states that the removal of the inequalities from the bed of the harbour has materially increased the flow of the tide, and assisted in deepening the bar; and that, if the impediments to the flow of the tide at the bridge were removed, the bar and the harbour would benefit thereby.

App. B. Nos. 246, 247, 248, &c.

The evidence and reports annexed will more clearly show the extent of benefit that may be fairly expected from the removal of these impediments; and the principle on which the increased flow of the tidal waters would produce that benefit, is clearly pointed out by Mr. Rennie and Mr. Walker, and other engineers, in their reports.

App. B. Ev. p. 478.

The registered tonnage of the port is 46,700, and the whole tonnage, with cargo inwards, in 1844, was 176,828 tons. The number of vessels entering the port amounts to about 3000 yearly, and it is also a place of refuge and resort for the British, French, and Dutch fishing-boats in the season; but there is great want of more accommodation, not only for the shipping of the port, but for vessels that are obliged to take the harbour in bad weather.

App. B. Ev. p. 478.

The vessels are moored at the north part of the harbour opposite to the town, and are so crowded together, lying end on to the pier, and across the harbour, that they take up a great part of the stream, and thus greatly impede the flow of the tide up and down. It is evident that an extension of the quay might be made at very moderate expense on both banks extending towards the entrance to the harbour, so as to afford ample room for all the vessels of the port to lie along the quay and leave the stream comparatively free. It was stated in the evidence that, by law, the right of way or quay extended along both sides of the harbour, from the bridge to the harbour's mouth; but it was also stated, that by sanction of the magistrates, and permission from the Lords of the Treasury, a part of the quay on the east side had, under the last Act, been given to private individuals, and a part of it also to the Trinity-house, whose premises interrupt that free quay down the banks of the harbours—there is, however, a path of 10 feet preserved throughout on both banks. Some of the witnesses recollected both sides of the river quite free, the whole breadth of the quay, and the whole length from the bridge to the harbour's mouth. Whether these encroachments have been made by proper sanction or not I could not learn, but it was certainly a dereliction from duty of the Yarmouth corporation to have allowed, under any pretence, so great an encroachment on the public quays. The means of additional accommodation for shipping will be suggested in another part of the Report.

As the command of backwater, to be used as a scour to the channel and bar, has been considered by engineers as one of the best means of securing deep water, there is no harbour in the kingdom that has a better reservoir for that purpose than Yarmouth, and I know of no place where the value of that reservoir has been so little known, or if known, where it has been
App. B. Ev. p. 474. so little used. It was stated by Captain Smyth that there were four and a half millions of tons of backwater received into and discharged from the harbour every tide, and that if the haven was widened at the bridge and entrance, there would be a material increase of that natural power.

The tide flows up through the bridge sometimes at the rate of five or six knots an hour into the large reservoir of the Breydon, and covers its large area from three to four feet deep at high water; there is along the south side of that reservoir a channel of from eight to ten feet deep at low water, until it reaches near to Burgh Castle, but at that place the waters from the rivers Yare and Waveney meet, and the eddy there produced has caused the upper part of the Breydon to silt up, so that there is only about three or four feet depth of water on the so-called Burgh Flats.

From the Breydon there are three separate rivers, up which the tide flows for 30 miles, namely, by the Yare to Norwich, by the Waveney to Beccles, and by the Bure to Coleshill. In these rivers and in the Breydon the great reservoirs of water are formed for scouring the harbour and bar of Yarmouth.

The revenue of the harbour in 1836 was 8,052*l.*, and in 1845, 12,495*l.*, showing an increase
App. B Ev. p. 474. of 4,443*l.* in the 9 years. The total amount of harbour dues collected for the 10 years since the passing of that Act, has been 102,970*l.*, the greater part of which has been expended by the harbour-master under the direction of the Commissioners, and without any scientific advice. For a harbour of so much importance as Yarmouth, and with so large a revenue, the best engineers should be employed to direct the expenditure for the works, having always in view its permanent improvement; and it will in future be the duty of the Board of Conservancy to take care that that is done in every harbour.

The harbour was under the management of the Corporation of Yarmouth until the year 1835, when a Mixed Commission was appointed, chosen by the counties of Norfolk and Suffolk, and by the city of Norwich and town of Yarmouth, as stated in another part of the Report.

The constitution of the Commission, by appointing the greater number of Commisssoners from Norwich and the counties of Suffolk and Norfolk, was evidently intended to prevent too great influence of the Yarmouth Corporation; but the general opinion is that the Yarmouth Commissioners, being always on the spot, have had too much influence in the management of the affairs of the harbour and navigation, and, consequently, have attended more to local interest than to general public good; and it is therefore desired by the best-informed persons, that there should be a portion of the Commissioners appointed by the Admiralty, on behalf of the public, to attend to the general management, and to protect the public interest against the interested views of the local Commissioners.

In my Report on Norwich, the manner in which the jealousy of the Yarmouth Commissioners has prevented the improvement of the navigation from that city to the sea at Yarmouth is more particularly pointed out.

Under the present Act, a portion of the harbour dues is paid to the members of the Commission from the city of Norwich, and from the counties of Norfolk and Suffolk, and they are authorized to expend that money in deepening and keeping open the navigation of the Yare, the Waveney, and the Bure, as they think fit, and to render an account thereof to the Commission in Yarmouth. The accounts of those several expenditures, and of the General Board, are directed by the Act to lie open to the inspection of all rate-payers interested; but, in practice, they never have been so prepared or asked for by any person. The treasurer pays money on the drafts of two of the Commissioners; and the Commissioners audit their own accounts.

The Commissioners are directed by the Act to appoint a Committee of Survey once in every three years to visit all the navigable rivers emptying themselves into the haven, and to notice
5 & 6 Will IV. c. 49, s. 29. the "abuses, impediments, and annoyances found therein, and to report to the Commission." These visits would be very useful if made in accordance with the spirit and intention of the Act, but in the ten years since the passing of the Act, only one such Committee of Survey (in June, 1843,) has been appointed, and the following extract from the Report of that Committee will
Report of Committee of Survey. point out what would be the benefit arising from such surveys:—"The Committee submit their report to the Commissioners under an impression that their inspection of the rivers will be found beneficial by bringing before the Commissioners impediments affecting the navigation and requiring to be removed, and works requisite to be done for its improvement, and that occasional surveys will be the means of preventing any encroachment on the rivers by affording to the Commissioners a full knowledge of the trusts confided to them, and enabling them rightly to decide on any applications that may be made for an appropriation of their funds."

If these Committees had accurate maps of the rivers, with the soundings, width, &c., throughout, their visits might indeed be very useful; but as there are no such maps, and as the members of the Committee must necessarily change in whole or in part at each visit, it must be evident that very little utility can arise from such surveys.

The history of Yarmouth, by Swinden, shows that the port and haven of Yarmouth has been of importance from very early periods, and that it has been improved at various times, by moneys from the public exchequer, from the adjoining counties, and from the inhabitants of the town; but those details are of no use for the future management, except to point out the necessity of constant attention to preserve and improve it, by the most skilful application of the revenues of the harbour.

Report of the Examining Commissioner.

App. B. No. 243.

The earliest inquiries and report on the Yarmouth navigation which have been furnished to the Commission, are those of Charles Labelye, C.E., dated January, 1747, which afford a most accurate description of the state of the harbour, the Breydon, and the dependent navigation of the rivers Waveney, Yare, and Bure; but much of its value is lost, owing to the want of the several plans and documents to which it refers; not one ancient map or plan of the haven by Labelye, or by any other person, has been found.

This is one of the cases which clearly shows the necessity of having some central office, where copies of all plans, as soon as they are proposed, should be deposited and preserved, in order that the opinion of preceding engineers, and the state of the harbour, and of the navigation at successive periods, may be laid before those persons to whom the condition of the harbour may at any time be submitted—to whom the experience of their predecessors, and the changes resulting from their works, would certainly afford the best guide for future improvements.

In every case that has fallen under my observation, the local authorities have failed to preserve these important documents; and, therefore, in future the local Commissioners, intrusted with the conservancy of harbours or navigable rivers, should, in every case, be obliged to send duplicates of all plans and reports of harbours and rivers, which, from time to time, may be furnished to or prepared for them, relative to the condition or improvement of their respective trusts, to the Admiralty or to the Board of Conservancy, should such be established, there to be preserved.

If such a regulation were carried into effect, the entire loss of such valuable information would, for the future, be prevented, and these periodical reports, and plans of alterations and new works, would afford to the Board of Conservancy in London knowledge of the actual state of every harbour, and also the means of immediately determining the general character and importance of any project for repair and improvement that might be submitted to them.

Although the plans referred to by Mr. Labelye have been lost, and although there are now no means of ascertaining the extent to which his recommendations have been carried out, yet some of the recommendations are so clear, and appear to be so strictly applicable to the present state of the haven, that I strongly recommend attention to these Reports.

App. B. Nos. 244, 245.

Although there are no reports of engineers on the haven, and no account of works done between the years 1747 and 1798 can be found, yet Mr. Jessop, who appears to have been consulting engineer, refers, in his Reports between that year and 1808, to other reports respecting the harbour which had been made during that period. He approves of the circumstantial report of Labelye; and his own reports would have been much more valuable if the other plans and documents referred to by him, in explanation of his views, had been forthcoming, as well as Labelye's report which he approves. Five of the most important of Mr. Jessop's reports on the haven are annexed.

App. B. No. 246.

The next report in succession is that of Mr. John Rennie, in 1819, in which the enlargement of the water-way at Yarmouth Bridge, and the preservation of the Breydon, as a reservoir for back-water, are the principal points recommended. He also advises that all the projections in the banks should be removed, with a view of increasing the flow of the tide.

App. B. Nos. 247, 248.

Mr. James Walker's two Reports in 1825 and 1826 are the last that have been made on the Yarmouth bar and haven, and his recommendations have been carried out to a certain extent. They chiefly relate to making the haven of uniform width, and to using the dredging-machine to attain a uniform depth, and other works recommended by preceding engineers: but, as regards the extension of the north pier, he differs in opinion from his predecessors. The north pier, which, since Mr. Rennie's report, had been closed to three quarters' flood, "had had the effect of stopping the sand coming from the northward, and thus of extending the shore or dry land north of the haven's mouth more to seaward, and of turning off the tide of flood from acting on the bar." Mr. Walker, considering that this had had a beneficial effect on the bar, recommended its further extension for 200 feet, and that recommendation has been carried out to some extent.

It certainly is a question of great importance, whether the extension of the north pier has had the effect of deepening the channel at the bar or not. The majority of those persons I consulted are strongly of opinion that a good *north*, or bank, extending from the north side of the haven to seaward, does produce a deep channel; but there are some facts in the history of the port, proving that there has been a greater depth of water at the bar, when there was no north pier, than there is at present, which render this opinion questionable.

App. B. No. 242.

By reference to Manship's "Manuscript History," it appears that the haven was formed in the time of Elizabeth; and it is stated that there were then 10 feet of water at the entrance at low water. No consecutive records have been found of the depth of water at the bar in the intermediate years; but, in the Report of Mr. Jessop, in 1798, it is stated that there were 9 feet water on the bar at low water. Some witnesses, on the contrary, state that within their time they have walked across the bar at low water. A few years ago there were only from 5 to 6 feet, but there are now 8 feet water on the bar at low water. These contradictory statements show how important it is that further information should be obtained on this subject.

The effects of prevailing winds on the state of the bar seem deserving of particular attention, as it is stated by some of the witnesses that the changes of the bar depend more on the prevalence of certain winds than on the form or extension of the piers.

The changes, also, which take place in the direction of the drift of the beach, on the several parts of the east coast, appear to depend on causes which have hitherto been little investigated, although it is well known that there are changes constantly going on in the form of the sand-banks and of the coast.

One means of ascertaining the cause of these changes would be, to make repeated accurate

APPENDIX A.

GREAT YARMOUTH.

No. 12.

Report of the Examining Commissioner.

Drift of the Beach.

surveys of the coast and sandbanks—to note the margin and configuration of both, and the corresponding changes that have taken place in the direction of the tides and the drift of the beach. Such facts would afford the best, and indeed almost the only, data by which an engineer might be guided in the execution of works for the preservation or improvement of harbour entrances.

Mr. Walker, whose reports have been mentioned, succeeded Mr. Rennie as consulting engineer to the Yarmouth Haven and Pier Commission, in 1825; but he has not, since 1835, been consulted in any matter connected with the harbour improvements.

I was unable to learn from the Commissioners why Mr. Walker had not been consulted; but I could obtain no sufficient reason from the clerk or any of the Commissioners; and for the last 10 years there has not been any engineer employed to superintend the works of the harbour, although a harbour revenue of 10,296*l.* a-year, on the average of those years, has been expended in works and repairs about the harbour and the river navigations connected with it.

Capt. Smyth, R.N., the pier-master, has the charge of the pier and haven, and has given much attention to the keeping up of the repairs, and to the general improvement of the harbour. It is only justice to Capt. Smyth to state, that there is one general opinion at Yarmouth that he has done his duty with great assiduity, and to the satisfaction of the Commissioners; but as Capt. Smyth is not an engineer, it appears to me that the Commissioners are to blame in having for 10 years expended so large a sum of money in repairs without the assistance of an engineer, who, by his previous information and professional knowledge, would have been qualified to have directed Capt. Smyth's valuable exertions, in the application of that money to the best advantage, for the permanent benefit of the harbour; and it will, I hope, be the duty of the Conservancy Board to interfere, and prevent such proceedings there, and at any other port similarly situated, for the future.

Report on Rochester Bridge, 1820, p. 30.

The history of every harbour and navigable river shows that changes are constantly going on, particularly when the sea and inland floods affect them; and the observations of Mr. John Rennie, C.E., in his Report to the Commissioners of the Navy on the 20th of May, 1818, are deserving of particular attention. He states that the entrances or mouths of all rivers are "in a state of decay, as to depth, by the settlement of the alumine brought from the interior of those counties through which they have their course; but this decay has been more observable of late years than formerly, on account of the improvements that have been going on in agriculture."

The embankment of lands over which the tidal waters flowed—the exclusion of the tide by locks—the erection of jetties, and other obstructions, by which the flow of the tide is impeded or land-floods checked—all cause mud to accumulate and banks to rise in the river, on its sides and at its mouth. Bridges, also, act like dams, and stop the current up and down, and contribute to the rise of shoals in rivers.

Bridge at Yarmouth.

My particular attention was directed to the present state of the drawbridge at Yarmouth, and to the numerous piles which had been driven in preparatory to the erection of a new bridge, and which have for two years, since the contractors became bankrupt, been allowed to remain in the stream or water-way, greatly impeding the flow of the flood tide into the Breydon, and also the return of the ebb. The water-way at the bridge was much too narrow before these piles were driven, and I found it a matter of surprise and of complaint with every person at Yarmouth with whom I conversed, except the Commissioners of the haven, that so great an impediment to the flow of the tide should have been allowed so long to remain there.

App. B. No. 246.

All the engineers have noticed the narrowness of the bridge, and its injurious effects on the harbour, as well as on the inland navigation; and Mr. John Rennie, in his Report to the Commissioners of the Haven and Pier, dated 29th of May, 1818, when describing the state of the bar and harbour, and the measures advisable for their improvement, states, that "to obtain a regular depth in the haven, between the high brush or interior part of the pier, the width of the pier should be reduced; and in order that the flowing of the tides may meet with as little obstruction as possible, all projections and irregular windings should be cut off, and *whenever a new bridge is required, the water-way should be enlarged,* and the channel scoured out and widened between thence and Breydon, in order that the tide may flow into this receptacle as freely as the nature of the case will admit, for the more water that flows into Breydon each tide the more there will be to return, and consequently the better the haven will be. The width of the channel, from Breydon to the bridge, should not be less than 200 feet, but as ships lie below the bridge, it ought to be increased in width. "At section No. 4 (by Preston's yard) it should continue as it now is at 240 feet."—Report p. 498. Mr. Walker, when consulting engineer, afterwards expressed the same opinion, that whenever a new bridge should be made, the water-way should be widened. In July 1835, when it was proposed to build a new bridge, Mr. Walker sent in a plan to the Commissioners, which would have given 150 feet of clear water-way, with 5 piers of 5 feet each, making the extreme breadth 175 feet, but his plan was rejected, and that of Mr. Birch agreed to, which would have given only 132 feet of clear water-way, being 6 feet less than the existing bridge of 138 feet of water-way. There is a mystery about the adoption of Mr. Birch's plan of which I could get no explanation. There is no record on the minute book of the reasons for the Commissioners having thus acted against the recommendation of the engineers. In the public Court I questioned several of the leading Commissioners of the haven, who were present when Mr. Birch's plan was preferred, in order to obtain an explanation of their reasons for adopting a plan which would narrow instead of enlarging the water-way, but I could not obtain from any one of them a satisfactory answer. The water-way at the bridge at Yarmouth is so narrow, that as Mr. Rennie has ably pointed out, it greatly impedes the free flow of the water up and down, to the manifest injury of tha navigation above and below it; the tide flows at the rate of 5 to 6 miles through the opening of the bridge, whilst in the pool and harbour the rate is only from 2 to 3½ miles in the hour. I am compelled, in the absence of positive information, to attribute this unaccountable conduct respecting the bridge to

See Plan, p. 506. App. B. No. 246.

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No. 12.

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the desire which has always been manifested, of opposing the navigation of sea-borne ships up to Norwich.

I heard complaints on many other matters connected with the management of the harbour, which I do not consider it necessary to state, and an opinion was very generally expressed, that it would be greatly for the benefit of the harbour, as well as of the public, and would give general satisfaction to the inhabitants, if Parliament would place the management of the harbour under responsible men, free from local influence and personal interests.

I entirely concur in that opinion, and strongly recommend, that for the better management of this and every other harbour in the country, a considerable number of the Commissioners should be appointed by the Conservancy Board.

In my Report on Beccles as a port, I have stated distinctly the course now taken by sea-borne vessels to and from Beccles by the Waveney River, since the connexion of the Waveney by Mutford Lock, through Lake Lothing, with Lowestoft Harbour. I propose, now, to show how the intention of the Legislature has been thwarted by the Commissioners intrusted with powers to improve the navigation between Beccles and the sea, by Yarmouth. The great benefits to those parts of the counties of Suffolk and Norfolk, "by the navigation from Yarmouth to Bungay, for the carriage of coal, corn, and other merchandize, by lighters, keels, and other boats of considerable burthen," are fully stated in the 25th of Charles II., entitled "An Act for making navigable the rivers commonly called Brandon and Waveney;" and the same has also been recognized by the several Acts passed since that time, for the improvement of the navigation of the several rivers emptying into the haven of Yarmouth.

12 Geo. III. c. 14. In 1772, an Act was passed "for depthening and making navigable the several rivers emptying into the haven of Yarmouth;" and a toll of one halfpenny per ton upon all goods imported by ships into that harbour was levied under that Act, "to be yearly applied for and towards deepening and clearing the river Waveney, for improving the navigation of the said river Waveney, and for removing all such impediments and annoyances as shall be found dangerous and hurtful thereto."

25 Geo. III. c. 36. In the year 1785 another Act passed, having, in the preamble, the words, "for depthening and making more navigable the several rivers emptying themselves into the said haven;" and the toll on goods imported was continued for that special purpose.

39 & 40 Geo. III. c. 4. In the year 1800 another Act was passed to continue the duties for these and the other objects stated therein.

5 & 6 Will. IV. c. 49. The provisions of all these Acts ought to have been carried out by the mayor and corporation of Great Yarmouth until 1835, when an Act passed, repealing all the previous Acts, and constituting a new Commission of 12 members, elected by the counties of Suffolk and Norfolk, the cities of Norwich and Great Yarmouth, and the preservation and improvement of the navigation of the Waveney from Yarmouth to Beccles remain now with that Commission. By that Act, part of the dues of the harbour are directed "to be applied" (sec. 93) "for and towards the cleansing and deepening the said river Waveney in such manner as the justices shall order." And by another clause (35), the Commissioners are empowered to take down and rebuild St. Olave's Bridge, and to deepen Burgh Flats, provided 7 of the 12 Commissioners shall sign an order to that effect.

I have considered it my duty to notice these several Acts to show that the intention of the Legislature, from the time of Charles II., has been to improve that navigation; and as the evidence, as well as the results of my own observation, show that the navigation of the river Waveney, from Yarmouth to the town of Beccles, continues to be interrupted by Beccles and St. Olave's fixed bridges, it would seem to have been the intention of the Legislature, in framing these Acts, that the Admiralty, as conservator of all the navigable rivers, should use such means as are in their power for the removal of all these nuisances to the navigation, and for the erection of swing or balance bridges in their stead.

From the present state of the navigation of the river Waveney, it must be evident that the Commissioners of the haven and pier of Yarmouth, intrusted by the Legislature with that important duty so distinctly pointed out in the Act of Charles II., and in every one of the subsequent Acts of Parliament, have not performed the duty intended. And it is also evident that the Lord High Admiral has not in any way enforced the powers he possesses towards the improvement of that navigation, and the public interests have been thereby neglected and injured.

It is proved most satisfactorily that every bridge, whether fixed or swing, interferes so much with navigation that it becomes the duty of the Admiralty to refuse their sanction for the erection of any *new* bridge across any navigable river, unless upon the most important public grounds.

Town Jetty. The attention of the Commission was also called to the Great Yarmouth Town Jetty, on the beach to the east of the town. It appears by the records of the town, that there has been a jetty there since 1702, and that the Commissioners of the counties of Norfolk and Suffolk, the city of Norwich, and borough of Yarmouth, granted 494*l.* for that object, and the Commissioners of the haven and pier have kept it in repair since then.

App B. Ev. p. 476. The evidence of the officers of the Coast Guard, and of several masters of merchant vessels, shows that at present great inconvenience and danger arise from the jetty not being sufficiently extended into the sea to allow boats to land at low water; that, in consequence, vessels lying in the roads have great difficulty in obtaining water and other supplies, and that, in some instances, they have been obliged to run for Harwich to procure them.

The necessity of providing better accommodation for the shipping in this particular is deserving of the attention of Her Majesty's Government and of the officers who may be intrusted with the future charge of this district.

This harbour is also considered capable of being converted into a harbour of *refuge*, so as to afford shelter in bad weather, and protection during war, to the numerous coasting vessels, sometimes, as elsewhere stated, amounting to 2000 sail, for which, in case of adverse winds, its roads are at present the only anchorage on this part of the coast.

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The extension of the quays would afford ample room for the shipping of the harbour; and if more room be required, there is an excellent place on the east side of the harbour, south of the gas-works, for a dock, capable of affording plenty of room for vessels delivering coals, or other cargo, much more conveniently than they now do in the stream, interfering with the flow of the tide. But there is also a very general desire that the harbour should be enlarged, to afford shelter for coasters near to the entrance; and although the harbour could only be taken towards high water, yet many of the witnesses strongly recommend the formation of docks, to receive the vessels that now lie at and upwards from the brush, often in tiers four or five deep, thus narrowing the stream, so as to render the passing of other vessels difficult. As there is good holding ground, vessels generally prefer lying in the roads to entering the harbour; but where vessels break from their anchors, or receive damage by collision, they would run for the harbour if room was provided, and the brush kept clear of vessels.

App. B. Ev. p. 476. There is near the brush, on the west side of the river, from the harbour to the cliff of Gorlston, a space now called Gorlston Marshes, which was formerly part of the channel of the river, which, at a moderate expense, could be formed into docks, capable of containing some hundred vessels. The openings of the dock might be made so as to admit very conveniently all vessels entering the harbour as a refuge, or lying there waiting for a wind, by which the brush and harbour would be kept clear, instead of being as now so crowded, that vessels often do each other damage in coming in in bad weather. It was confidently stated, that if these docks were made, and the entrance improved as it ought to be, by the removal of the impediments pointed out elsewhere, 50 vessels would take refuge there in bad weather where 1 vessel now does. When, from the prevalence of strong south or north winds, the roads become crowded with vessels, the greater number of them coasters, all those which are badly found in cables and anchors, or short handed, would seek shelter in such harbour rather than run the risk of riding out a strong gale during a winter's night, and by that means many vessels and their crews might be saved.

I have at times seen Yarmouth beach, south and north of the harbour, strewed with wrecks, many of which, if the accommodation pointed out had been made, might have been prevented. I would therefore, while public attention is directed to the formation of artificial harbours of refuge, press on the consideration of Government, that the public money would be well applied in aid of such a national undertaking, for the preservation of life and property in this, one of the greatest and most dangerous thoroughfares on our coast.

See Plan, p. 566. It is, however, to be regretted that the Mayor and Corporation of Yarmouth should, in 1813, have permitted the enclosure and alienation of the very lands required for that purpose, viz., the Gorlston Marshes before alluded to (coloured green in the map), which contain about 44 acres. Some of the witnesses stated that before the enclosure they had sailed over them in boats, and that even now they are at times covered by the tides; and from the levels furnished by Captain Smyth, it appears that but a very moderate amount of excavation would be required to form them into the very docks in which vessels could obtain the requisite shelter in stormy weather, or when wind-bound.

49 Geo. III. An Act to enclose lands in the parishes of Corton Hopton and Gorlston, in the county of Suffolk, included these 44 acres; and it appears by the letter of the town-clerk, that there is no minute or record of the sanction of the Haven Commissioners, or of any opposition to that enclosure.

This affords another instance of the many that have come to my knowledge, of the inadequacy of the present arrangements to protect the public property from encroachment. The only means by which the Admiralty or Parliament now obtains information of any intended encroachment on the tidal lands is, the opposition occasionally offered by interested persons.

In this case we have no means of judging whether the want of opposition arose from ignorance or from collusion; but it is evident that proceedings equally injurious to the public interests must often take place, under the present system, as there are no means of effectually preventing them. These 44 acres, so much required, must now be purchased from the present proprietors before they can be applied to the public use.

If the Board of Conservancy shall be established, as recommended in the First Report of this Commission, proper information and superintendence will prevent a similar loss to the public in future.

In the improvements of the haven of Yarmouth and of the navigation to Norwich the towns of Yarmouth and Norwich are equally interested, and should make common cause to remove, with the greatest possible expedition, the obstacles to an easy and expeditious communication by water between Norwich and the sea, viz., by the natural courses of the Yare, Breydon, and Yarmouth.

In 1840 the refusal of the corporation of Yarmouth to admit Norwich to a sea communication, obliged the inhabitants of Norwich, at a very great expense, to seek a sea communication by making a new harbour at Lowestoft, by which, though with difficulty, vessels of 100 tons burthen now pass to and from the sea. If one half the sum expended on that harbour had been expended in deepening Burgh Flats and the Breydon Water, in widening the water-way and the bridge at Yarmouth, and improving the haven at its entrance, as recommended by several engineers, there would at this time have been a suitable communication, and the rivalry between Yarmouth and Lowestoft would not have existed.

For, as I have stated, the natural and easiest communication between Norwich and the sea is by Yarmouth, and the interests of both towns are identical. The active competition of the Lowestoft navigation, and especially of the railroads, to obtain the traffic of Norwich and the country around it, is more likely to affect the trade of Yarmouth now than at any previous time; and it behoves the corporation, therefore, instead of raising every possible difficulty, to afford every possible facility to the navigation to and from Norwich.

JOSEPH HUME.

No. 13.

PORT OF WELLS.

Mr. Hume's Report. 1846.

Report of the Examining Commissioner.

I visited Wells in October last, having previously given notice of my intended visit, and the inquiry was conducted in open court, several of the Commissioners of the harbour, the principal inhabitants of the town, and some of all classes being present.

The port of Wells, situated on the north coast of Norfolk, affords a striking example of injuries to the harbour from the encroachments of landed proprietors on lands covered at a former period by the tidal waters, and also from mismanagement under powers recently granted by Act of Parliament. App. B. Ev. p. 437.

The Commissioners of the harbour could produce neither records nor maps to show its past or present condition; and the only information I could procure respecting it was obtained from the pilots and other witnesses present, and from the map annexed to Mr. Joseph Hodskinson's report in 1782 on the state of the harbour.

The harbour may be described as a creek or collateral arm of the sea, which enters from a beach of sand and shingle, runs through sand for one mile and a half, then between two ranges (See Plan, p. 466.) of low sand hills called the Meals, and lastly through a marshy estuary up to the town of Wells. The marshes between the Meals and the main land are intersected by numerous small creeks, or fleets, as they are termed, the whole of which formerly branched out east and west from the main channel, and freely admitted the tidal waters throughout.

The whole area of these marshes on the map is stated to be 2563 acres.

The harbour is five or six miles to the westward of Blakeney, and its entrance is about three miles north of the town of Wells; and as no fresh water runs into the harbour, its maintenance is entirely dependent on the flux and reflux of the tide.

The entrance channel is buoyed off, and is from 30 to 40 fathoms wide. The bar and the channel up to the quay are now partially dry at low water.

There is a rise at high tide in ordinary springs of about 21 feet at the bar, which gradually decreases to a rise of about 12 feet at the quay, and the difference in the times of high water at the bar and at the quay is about an hour and a half. Captain Welsh, Inspecting Commander, stated that he had seen extreme tides, when there was 26 feet water on the bar, and 16 feet at the quay.

In the year 1782, at the time the proceedings at law were going on respecting the enclosure (App. B. Nos. 229, 230.) of tidal lands, surveys and reports on the state of the harbour were made by Mr. John Smeaton, Mr. Joseph Hodskinson, and other engineers. The map accompanying Mr. Hodskinson's Report, in the accuracy of which I have confidence, is annexed in order more clearly to explain the several encroachments made within the tidal lands of the harbour, and also the changes which appear, in consequence of these encroachments, to have taken place. It appears that three large embankments were made for enclosing tidal lands within this harbour in the last century.

The first enclosure of 668 acres to the west of Wells town, viz., of 560 acres (No. 1 on the map) by Lord Leicester, and of 108 acres (No. 2 on the map) by Sir Charles Turner, lords of the manors, was made about the year 1719, but it does not appear upon what authority all that enclosure was made.

The second embankment by Sir Charles Turner, enclosing an area of 110 acres, called the Church Marsh, on the south side of the harbour of Wells (No. 6 on the map), in nearly the (See Plan, p. 466.) highest part of the marshes, was made in 1720; but the engineer, as if aware of the damage which the exclusion of the water would cause, appears to have made the bank so as to allow of a partial flow of the tide beyond that enclosure into the Warham Slade (No. 7 on the map).

The effect of these enclosures soon became evident; for in 1725 it is stated by Mr. Baderslade, in his treatise on the state of navigation, "That since a considerable number of acres of salt marsh has been embanked at Wells, and several creeks have had banks run across them, the harbour of Wells, its channal and pool, have very sensibly decayed, as have done all channels that have been by any ways deprived of their back water."

I have not found any record to show what was the depth of the channel before the embankments in 1719, but it is admitted to have greatly decreased from that period; for in 1738 a sluice, called Fruston's Sluice, was constructed to arrest the deterioration or filling up of the harbour then complained of.

This work is stated by Smeaton to have had for the time a beneficial effect, and "that part of the channel called the Pool was then (in 1738) so deep, that at low water two or three tiers of (App. B. No. 230.) vessels would lie afloat and swing round;" but, nevertheless, in 1782, the Pool had filled up so much, that at low tide there were only six feet water there.

Although, therefore, it was generally known and believed, that the deterioration or filling up of the harbour had been caused by the enclosure of the marshes in 1719 and 1720; and although the erection of a sluice had not arrested the filling up of the channels, yet in the year 1758, Sir John Turner, by another embankment, excluded the tidal waters from 66 more acres of the highest part of the marsh, called the Warham Slade, thereby completing the enclosure of 844 acres out of the 2563 acres, that in 1719 were covered with water at every tide.

Mr. Hodskinson states that these embankments of one-third of the whole marshes, creeks (App. B. No 229.) and fleets, by diminishing the volume of water received into the great natural reservoir, and, consequently, weakening its re-acting power on the siltings and deposits in the channel, were the main cause of the obstructions in that harbour.

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He expresses also a strong, and, I think, a correct opinion, that each successive embankment was more injurious in proportion as it was further removed from the sea; for the greater the distance from which the waters begin to ebb towards the mouth of the harbour, the more effectual is their scour during the last quarter of the ebb.

He estimates the total scouring power in the harbour before 1719 at 1,050,754 tons every tide, and that the enclosure of the 844 acres had reduced the scour to 468,120 tons; but if raging tides, such as happened a few days before I visited the port, are to be taken into account, the loss of scour on one such occasion must have been more than 2,000,000 of tons.

The opinions of Mr. Hodskinson were approved also by Mr. John Grundy and Mr. Thomas Hogard, civil engineers.

App. B. No. 229. Mr. Joseph Nickalls, civil engineer, also surveyed the harbour in 1782, and stated as his opinion, that in 1719, before the embankments (Nos. 1, 2, and 6 on the map), the surface channels and creeks admitted at many spring tides four millions and a quarter tons of tidal water, which he designates as "the great efficient and operative tides" for the preservation of the harbour. He agrees with Mr. Hodskinson, that unless the Warham Slade embankments be removed to admit of the flow and reflow of the tidal waters therein, the harbour must be destroyed.

It may be supposed, that if Sir John Turner could have foreseen the injury to the harbour of Wells from the embankments, he would not have acted as he did; but it is probable that he entertained the opinion, still held by some persons at this day, that the embankments of tidal lands never do injury to harbours.

App. B. No. 228. The Commissioners of the harbour, however, thought differently, although too late to prevent the injury that had been done. And, in 1778, they laid a case before Mr. Serjeant Grose, and obtained a distinct opinion that all embankments, which by preventing the flow and reflow of the tides, stop up the harbour, and are prejudicial to navigation, were nuisances at the time they were made; and by the verdicts of three juries, in the trials between the Commissioners and Sir John Turner, it is evident that the juries were of that opinion also.

App. B. No. 230. I have perused with attention the Report of Mr. John Smeaton, then employed by Sir John Turner to report on the state of the harbour, the causes of its decay, and the best means of improving it. And I state, with regret, that his opinion appears to be at variance with the facts of the case, and at variance also with his opinions given in other reports on tidal matters. He states, that "It has been clearly shown that as the keeping open and maintaining the channel of the harbour of Wells entirely depends upon the reflow of the tidal or back water, that whatever cuts off and diminishes that must be a detriment to the scour, and consequently to the maintenance of the channel."

He also admits "that the harbour of Wells has become worse than it formerly was, and particularly since the embankment of the 668 acres in 1719." And although these embankments had shut out millions of tons of water in raging tides, and consequently prevented the back-water scour, "Yet he entirely acquits the whole of the embankments of having been in any degree accessary to the disagreeable effects arising from the changes in Wells harbour;" and he states distinctly, his opinion, "That as for the decaying state of the harbour of Wells, we must seek some cause widely different from the embankment of the marshes."

App. B. No. 226. I must here observe, that in 1767, when he reported on the harbour of Lynn, in Norfolk, the following extracts will show what his opinion then was of the effects of embankments:—"I believe all agree in opinion, that in the situation of Lynn harbour, the greater the *efflux*, which in a great measure depends upon the *influx*, the better channel may be expected to be maintained: too great tides may be a partial and temporary evil, but it appears to me, in the present case, a fault on the right side." He further states—

"The simple point of view, that in my opinion is necessary to be attended to for the preservation of the channel, is to do nothing materially to affect the indraught of the tides, or to diminish the quantity of fresh water coming down the river from above: as to the rest it may be left to nature." And he adds—

"I have already declared my opinion is, in general, to discourage all attempts to prevent the free *influx* and *efflux* of the tides and land-waters, in order to preserve the channel out to sea in the most effectual manner." And he concludes—

"I entirely disapprove of all jetties built into the stream as a defence for saving the banks or foreshores from the action of the water, as I am convinced they have a contrary tendency. All angles are to be avoided, and the natural sweep of the river kept."

Sluices.

I would here call attention to the question, whether reservoirs and sluices for tidal waters answer the purpose of scouring and keeping the channel of harbours deep. At Wells, when the harbour deteriorated by the embankments, a sluice was erected in 1738, and was repaired in 1765, and at subsequent periods, but it does not appear that any permanent depth of channel was derived from it. At present there is no sluice.

Mr. Hodskinson considered sluices of little use to keep a harbour clear, in comparison with the free flux and reflux of tidal waters; and, in the case of Wells, he stated, that they could not, in any perceptible degree, make amends for the loss of the back-water shut out by the embankments.

The opinion I have formed of the effect of sluices at Shoreham Harbour, at Dover, and other places which I have visited, is, that they are of little or no use, except as causing deeper water immediately beyond the spot where erected, and thus they generally make only deep holes with banks of earth and sand raised beyond them.

At Wells, I think the sluices must have hastened the accumulation of soil in the east marshes, by allowing the deposition of mud where the water was confined and stagnant for so many hours of each tide, and thereby actually did injury.

Mr. Smeaton states that the sluices, as long as they were in good order, kept the channel

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deep, but it is evident that all the while the pool and channel, at some distance below the sluice, were gradually filling up, and there is no evidence that the sluices were of any utility except in their immediate vicinity. Although, by the decision of the Court of Chancery, an injunction which had been granted by that Court in 1781, restraining the Commissioners "from removing the banks across the Warham Slade of 66 acres" was dissolved, and they were at liberty to throw them down, I do not find that the banks were ever actually removed, so as to admit the flow of the tide over the enclosure as formerly.

But there is a minute in the book of the Harbour Commissioners, dated the 29th of January, 1808, stating that Thomas William Coke, of Holkham, who had succeeded as proprietor to the lands that had belonged to Sir John Turner, made a proposition to the Commissioners to cut a canal, or reservoir, in Warham Slade, that should admit as great a quantity of water as then covered the marshes in ordinary tides, and, by means of sluices to be made at his sole expense, he would cause a better scour to the harbour by the back-water to be thus produced, than was produced in ordinary tides.

App. B. No. 231.

The Commissioners consented to the offer, and Mr. Coke was allowed to embank the whole of Warham Slade marsh, so as effectually to shut out the tide; but the reservoir, although commenced, was never finished, nor the sluices erected, and the tide, being thus completely shut out, and no back-water produced, there was consequently no scour to the harbour, as agreed upon, and the surface, at the spot where the reservoir was begun, is now level with the rest of the land.

App. B. Ev. p. 437.

It is a singular circumstance, that the opposition to the embankment of the tidal lands of Warham Slade, which former Harbour Commissioners had maintained for more than 30 years at so great an expense, was thus frustrated by the act of the Commissioners themselves, who quietly yielded to Thomas William Coke the whole of the contested enclosure, and thereby deprived the harbour for ever of the back-water for which their predecessors had so resolutely and so successfully struggled.

Of the total area of 2563 acres which was covered by tidal waters previous to the year 1719, there are now only three salt marshes (Nos. 3, 4, and 5 upon the map), containing 1719 acres, over which the tidal waters flow at spring tide.

After the proofs already adduced of the injury sustained by the harbour from the embankment of its tidal marshes, it seems strange that any later proposal should have been entertained for the enclosure of a further portion of the remaining area. But so late as 1844, a plan was proposed for the enclosure of the whole of the West Marsh (No. 3 on the map), containing 580 acres; and the sole reason that it was not carried into effect appears to have been the expense of the works required for the exclusion of the tide, and the drainage of the lands, which would have exceeded the value of the lands reclaimed.

Two Reports were made in 1844-5, by the engineer employed to decide upon the merits of the proposed embankment, and I refer to these Reports, as it becomes my duty to state, that I entirely differ from him as to the effects which the proposed works would have produced upon the harbour.

App. B. No. 234.

If an estimate be made from the facts stated in these Reports, it will be found that the quantity of water which the proposed embankment would exclude at ordinary spring-tides from only 330 acres of this area (250 acres being only partially covered) will be found to exceed 580,000 tons, and "the loss of this amount of tidal water in such a harbour as Wells is certainly a matter for serious consideration, as upon the sufficiency of the scouring effects of the ebb and flood tide the channels of such a harbour entirely depend." And how much more important will the exclusion of the tidal waters from this area appear, when it is added, that in the high tides which often occur on that coast, this area would be covered to the depth of five feet by upwards of three millions of tons of water.

App. B. No. 234.

It appears to me, to use Mr. Rendel's words, "that the more direct action of the stream on the harbour channel" might be attained by keeping the marshes unenclosed, and throwing open the mouths of the fleets on both sides of the harbour, so as to admit the greatest possible quantity of water to the utmost extreme of the marshes, "by which each secondary fleet would become a cataract down which the water rushes into the principal fleets, and by that means they are scoured," and the channel of the harbour would be deepened by the natural action of the tidal waters.

In addition to the western marshes which have so narrowly escaped enclosure, there are 1130 acres on the east side of the channel (Nos. 4 and 5 on the map), which are now covered to the depth of between one and two feet at ordinary spring tides, and hence they have about two millions of tons of water, at spring tides, for the scour of the harbour; but this body of water is not allowed to flow directly into these marshes, because dams are placed across the mouths of the fleets or channels, so as to direct the stream into the upper part of the harbour round by the quay.

Although this expedient has temporarily deepened the channel near the quay, in consequence of the whole of the water that covers the marshes and fleets passing directly up and down, the area, still unenclosed, is perceptibly silting up, and the tidal influx daily diminishing.

Many of the witnesses I examined stated, that since 1818, when the last dam was erected, the channels or fleets at the outer extremes of the marshes have filled up, and that the whole area is perceptibly shallowing.

App. B Ev. p. 437.

As it is evident that, if the present course be pursued, a time must speedily arrive when these marshes will have silted up to the level of high water, and the harbour be thus deprived of nearly two-thirds of its remaining back-water, I would, therefore, urgently recommend that the main channel of the harbour be dredged throughout, and every fleet opened to the freest possible action of the tidal water, as I am confident that no other means can save the harbour from destruction.

When means are so much required to avert such a result, it is painful to me to notice the state of the finances of the harbour, and the misapplication of the money at the command of the Commissioners.

Several Acts of Parliament have been passed for the improvement of the harbour since 1663, but I shall confine my remarks to the proceedings under the 7th of Victoria, 1844, "An Act for improving the Harbour and Quay of Wells."

App. B. Ev. p. 438. I refer to the evidence taken in open court at Wells, and to a petition since then laid before the House of Commons and the Tidal Harbours Commission, from the merchants and ship-owners of the port, for the details of the mismanagement which has been going on since the passing of that Act.

It sanctions the borrowing of 9,650*l.* for the erection of a stone quay, which I found in progress.

I found, on examining the Commissioners and their account books, that great irregularities had occurred, and were going on, not only in the keeping of the accounts, but also in the receipt and payment of large sums of money for the alleged purposes of the said Act.

App. B. No. 237. As stated by the petitioners, Mr. Southgate, "One of the Commissioners, holds the offices of treasurer, secretary, collector, superintendent of steam-tug and public works, and is deriving considerable profits from the said offices and from the said works; that large sums of money had been expended extravagantly, and without consulting any practical engineer or experienced surveyor; that such sums had also been expended without public tender or contract." Mr. Southgate has also the whole management of the works and finances, without even the check that would be afforded by the assistance of a clerk, or the employment of a practical engineer.

I called for a return of the receipt of customs at Wells, and find that the amount of customs duties, in the year 1830, was 4,511*l.*; in 1840, 596*l.*; and, in 1845, only 168*l.* And although the shipping in repeated voyages has remained at about 22,000 tons yearly, a note to the same return states, that the Port of Wells is to be reduced to a creek, dependent on the Custom-House of Cley, from the 5th April, 1846. Although the harbour has so much deteriorated, no portion of the harbour dues, or of the money borrowed, has been applied to dredge or deepen it; but a heavy debt has been contracted for the stone Quay, that will soon be useless, if the harbour continues to silt up, as it must do under the present system.

The average revenue of the port for the three years 1842, 1843, and 1844, was 652*l.*, and therefore the application of 332*l.* to the payment of interest on the 9,650*l.* borrowed to build the quay, absorbs more than one half of the annual revenue, and must henceforth prevent the requisite outlay for the improvement of the channel and harbour. Mr. Southgate is collector of the harbour-dues of the port, and there is reason to believe that he does not keep a correct account of their receipt, as he was unable to comply with the order of the Board of Customs, so as to distinguish the amount of dues received from foreign and from British ships. If the accounts of the harbour-dues be transmitted to the Admiralty or Conservancy Board by every Board of Commissioners, as recommended by this Commission, no such proceedings could take place. Mr. Southgate signs himself Clerk to the Commission in the Returns to Parliament, whilst he is a member of the Commission, and executes all the other functions, as already stated. App. B. Ev. p. 438.

The merchants and inhabitants of Wells justly complain of the heavy burdens imposed on them by such gross mismanagement; but, as in many similar cases, they have neither power to interfere nor prospect of redress, as the Commissioners named in the Act, who now promote such mismanagement, and many of whom do not even possess any property in the town, have the power by the 5 and 6 Wm. IV. c. 48 (1835), of nominating Commissioners to fill up vacancies.

I have gone more into details respecting the Port of Wells than the size and importance of the place may seem to warrant; but having found in its history and management almost all the several evils complained of in the first Report of this Commission, I have considered their separate exposition as so many arguments of the necessity of viewing the navigable rivers and harbours of the country as public highways, and depôts for the benefit of the community at large, and of Government's becoming, under that view of the case, itself their conservator.

JOSEPH HUME.

No. 14.

PORT OF CLEY AND BLAKENEY.

Mr. Hume's Report.

No. 14.

Report of the Examining Commissioner.

March 13, 1846.

App. B. Ev. p. 467.

On the 28th of October, 1845, I visited the harbour of Cley and Blakeney, inspected the localities, and afterwards took evidence as to the past and present state of that harbour. I was attended by inhabitants of the town and neighbourhood, and pilots who gave information in open court. These towns are on the north coast of Norfolk, distant to the west from Cromer about 12 miles, and about 1 to 1½ miles from the sea.

Although the towns are separate and distant from each other, and have separate quays, yet they have a common entrance from the sea.

The town of Cley is on the bank of the rivulet of Glaven; the sea, in a direct line to the north, is a full mile from the town; and formerly the lands to the north and east of the town, and extending to the sea-shore, were covered by ordinary spring tides.

See Plan, p. 472.

By a map of the year 1586, procured from the late lord of the manor, it appears that the entrance of the harbour was 1½ miles to the westward of the town of Cley, and ran in an easterly direction in one broad channel until opposite the town of Cley, when it divided, the larger branch running south up to the town of Cley, and forming the entrance of Glaven river; the narrow branch trending due east into the Salt-house Broad.

I examined the Salt-house Broad, extending several miles from Weyborne westward to Cley Marshes. The present area of the Broad is considered to be between 500 and 600 acres, and the rise of the tide through the Shingle Bank on each side is now several feet; but the communication which, as appears by that map, formerly existed, is now closed, although within the memory of some of the witnesses, there was a passage to admit boats from Cley harbour to the Broad.

App. B. Ev. p. 467.

See Plan, p. 472.

The tidal lands north of Cley, and on each side of the channel up to the town, have been enclosed within the memory of some of the witnesses, although there is no record of the authority by which that enclosure was made; and it will be seen by Mr. Palmer's map of 1835, that the area of the enclosure on the east side of the Cley channel (No. 1) is 431 acres, and the area of the enclosure on the west (No. 2) 590 acres; by these the harbour was deprived of the benefit of the tidal waters that covered these 1021 acres.

App. B. Ev. p. 470.

Before these enclosures, the flow in ordinary tides, taking it at the extent of only two feet water, must have afforded the scour of upwards of two millions of tons at each tide; and on high tides, such as had taken place on the 20th of Oct., a few days before I visited the place, there would have been seven feet water at the least on the marshes, as appeared by the mark of the tide fresh on the embankment, and that tide would have given a scour of upwards of seven millions of tons.

The channel which ran to the Salt-house Broad, between the embankment on the south and the Shingle Bank on the north, was closed by the shingle being forced inwards by the sea, so as to join the north side of the embankment. It is evident if that embankment had not been formed, that the tidal water would have resisted the encroachment of the beach, and thus have preserved to the harbour not only the scour of 431 acres, or one million of tons of water, but it would have preserved the scour of another million for the Salt-house Broad.

App. B Ev. p. 467.

The depth of water up to the town of Cley, so late as 1824, admitted vessels drawing 9 feet water at the quay, where they could swing; and now vessels drawing 6 feet water can with difficulty come up, and the channel is so narrow that they are unable to swing.

App. B. Ev. p. 470.

The town of Cley in 1824 carried on a considerable trade, and had several general merchants; and now there is little trade, and only one merchant remains. All property in the town except land has decreased in value 50 per cent.; and many premises formerly in demand cannot now be let or sold on any terms. The population, which in 1831 was 828, has since that period remained stationary.

Although, from the want of maps or documents which might afford information of the past state of the harbour, the exact progress of its deterioration cannot now be accurately determined, yet there is one concurrent opinion in the town and neighbourhood, that the source of the evil is to be found in the enclosure of the tidal lands, and the consequent obstruction of the free flow of tide; and the following detail of the effects of the last enclosure, made in 1824, affords another striking proof of the mischief resulting from these inconsiderate proceedings.

App. B. No. 239.

The tide flowed up the river Glaven for 2¼ miles beyond the town of Cley, as far as Glandford mill; and in spring tides, an area of 238 acres of marsh lands, on the sides of the river, was wholly covered to the depth of two feet; and Mr. Wm. Cooke, the present miller of Glandford mill, states, that in 1820 the depth of water in ordinary spring tides was from four to five feet in the channel up at the mill; that the fall of water from the mill-dam was six feet; that in high tides the water had risen to that level; and, on one occasion, the tide rose nine feet at the same place.

The quantity of tidal water therefore that flowed up to Glandford mill, beyond the town of Cley, over these 238 acres, at each spring tide (with four feet in the channel of the river) may be estimated at 700,000 tons; and when the tides rose six feet at the mill, the quantity of tidal water available for the scour of the harbour would have exceeded two millions of tons.

App. B., Ev. p. 467.

It appears that the proprietors of the lands adjoining the river Glaven in the parishes of Cley and Wiveton, obtained a Bill in 1820, "for embanking and draining lands in the parishes of Cley and Wiveton," and part of the preamble sets forth that power is to be given *"to inclose common and salt marshes, subject to be overflown by the waters of the sea."* If there had been any efficient person to act as conservator of harbours, whose special duty it would have been to attend to such bills, it is quite evident that no such power would have been granted. The want of such a conservator has led to the evils herein detailed.

App. B. Ev. p. 468. The minutes of the commissioner for that enclosure show that reports had been made by several engineers, as to the mode of executing the requisite works, both as to their expense and to the prospective effects upon the navigation of the harbour. Mr. Telford stated "that from all the experience he had had of tidal rivers, both connected with navigation and drainage, he was convinced that both these objects are materially concerned in preserving a good outfall; and that this was to be most effectually obtained by suffering a free and full flux and reflux of tidal water as far as possible into the country;" and he added, "that all other attempts by means of sluices have uniformly proved not only ineffectual, but prejudicial." And it is stated, that he expressed an opinion to the proprietors of lands, assembled on one occasion to consider the several plans, "that the proposed embankments at Cley would not only destroy Cley harbour, but would throw up an obstruction or bar in Blakeney harbour, and he, therefore, recommended one open channel to Glandford mill."

Mr. Telford's advice and plans were rejected, and his predictions have been fully verified, as Cley harbour has been ruined. The channel is only one-third of its former width, and has become tortuous, and full of shoals; the sea has washed the sand into Blakeney harbour so as to fill up the pit, and the harbour no longer affords refuge to the shipping, as it is stated formerly to have done. In respect to the last enclosure of 238 acres of tidal land, which seems to have completed the ruin of the harbour of Cley, the promoters of that encroachment derived no benefit from it, as the expenses of obtaining the Act and carrying it into execution App. B. Ev. p. 470. amounted to 9,008*l.*, and although the whole of the enclosed lands were sold, the proceeds, being only 7,071*l.*, were insufficient to discharge that amount, and the promoters were obliged to pay the balance of 1,937*l* from their own funds.

App. B. No. 230 *a.* The general history of Norfolk shows the importance of Blakeney port at former periods, when it was much frequented by merchants from Germany. Since 1831, the population has increased from 929 to 1,021, and the chief part of the trade of the port is carried on there.

App B. Ev. p. 467. The bar at the entrance of the harbour has always been a shifting bar, and dry at low water; and within the last 25 years the entrance has shifted a quarter of a mile to the westward. The rise of tide there on average springs is 16 feet, and 9 feet at the quay at Blakeney; the distance from the bar to the quay about 3½ miles. In 1817, a Bill (59 Geo. III., 59 Geo. III. c. 49. c. 49) was passed, for *improving the harbour of Blakeney within the port of Blakeney and Cley*, and authorizing a joint stock company to make a cut of 500 yards to straighten the channel from the quay towards the north, and to place buoys, &c. This cut was executed, and the channel shortened; the depth of water has since then increased at the quay, and its navigation has been improved. Some of this improvement, however, is attributed to the diversion of the water of the Agar Creek on the west side of the harbour.

See Plan, p. 472. The Agar Creek, extending west from Blakeney harbour to the Morston Creek, admitted the tide from both ends to cover an extent of 400 to 500 acres of marsh lands at high water (No. 4). The proprietors of the harbour obtained permission from the lord of the manor to place a dam across the sea mouth at the Morston Creek, and thereby divert the waters of the flood and ebb so as to pass round by the quay. Although the depth of water at the quay and in the new cut may be increased by that means, it appears to me certain that the obstruction of the direct and natural action of the waters covering that large area, must cause the whole of that surface gradually to silt up, and in course of time the Agar Creek itself will be obliterated.

It would seem that as the amount of scouring power has been diminished by the several enclosures of tidal lands, the natural tendency of the water to maintain a direct course to and from the sea has been insufficient to resist the westward drift of the beach, and thus the entrance of the harbour has been gradually forced to the westward, and as every diminution of the scouring power must increase that evil, the erection of the dam across the Agar Creek, by obstructing the tide, must, in my opinion, be viewed as having contributed to it.

It therefore appears necessary that no lord of the manor should have the power of interfering with the course of tidal waters, thereby to do injury to a public harbour.

App. B. Ev. p. 471. The works under the Act of 1817 were executed at an expense of 1,930*l.*, raised by 39 shares of 50*l.* each, and the revenues of the harbours of Blakeney and Cley are granted *for all time* to that company. Schedules are annexed to the Act. All vessels entering the harbour pay tonnage dues, and additional dues are levied on the cargoes of such vessels as pass through the New Cut.

The revenue of the harbour, in the three years 1842, 1843, and 1844, was 1,327*l.*; and the amount expended on the salaries of the servants and on the repairs of the harbour was 485*l.*, leaving the sum of 833*l.* to be divided amongst the 39 shareholders, being a dividend at the rate of 14½ per cent. per annum.

There is no provision for the repayment of the sum expended on the harbour, nor any limitation of the dividends. None but shareholders can have any management of the harbour affairs; and the directors are self-elected by and from amongst the shareholders.

I call the especial attention of the Board to the fact, that in this case not only has a *public* harbour been almost destroyed by the encroachment on its tidal lands, but it has also become the property of a private company, who profit largely therefrom.

Although the smallness of the revenue of the port of Cley and Blakeney, and its present deteriorated state, render it of little importance as a harbour when compared with others more wealthy and prosperous, yet the demonstration of two clear cases of injury, arising from causes to which Her Majesty has specially directed our attention, will, I think, add weight to our recommendation, that measures should be taken to remedy existing evils of this nature, and to prevent their recurrence in future.

JOSEPH HUME.

No. 15.

NORWICH.

APPENDIX A.

NORWICH.

No. 15.

Report of the Examining Commissioner.

Mr. Hume's Report.

THE Commissioners, attended by Mr. Springfield and two other river Commissioners, by Capt. Smyth, R.N., pier-master, and Mr. Curtis, C.E., commenced the survey at Yarmouth Bridge, and proceeded in a steamer through the Breydon and up the Yare to Norwich. The harbour of Yarmouth is on an average 255 feet wide, but at the bridge it is only 146 feet, and between the bridge and the Breydon it enlarges to a width of 330 feet.

The depth at the bridge is 21 feet. The river Bure enters the Breydon from the north, a short distance to the westward of the bridge, and a knoll or shoal is thrown up by the eddy of the waters of the Bure opposite its entrance.

In 1826, Mr. James Walker was directed by the Commissioners of the haven and piers to survey the Breydon and the rivers flowing into it, and to report on the practicability of making it navigable for vessels drawing 10 feet water. The necessary plans, surveys, and sections had been previously prepared by Mr. Timperley, and Mr. Walker having given the subject his best consideration, had no hesitation in reporting that it could be made navigable for vessels of that draft of water. App. B. No. 257.

The Breydon is a long oblong reservoir, its whole length extending from Yarmouth Bridge four and a half miles to the river Yare. Generally its greatest breadth is about 4000 yards, and the whole area is estimated at about 1600 acres. Along the south side of the Breydon from the bridge the channel is 9 or 10 feet deep at low water, but at the western end from the Upper Cross to where the Waveney and Yare enter, it is shallower, having for some extent below Burgh Castle, at a part called Burgh Flats, only 4 or 5 feet water.

In 1826, Mr. Walker estimated the expense of dredging the whole length of the Breydon, including these flats, so as to form a navigable channel of 100 feet wide and 10½ feet deep from the bridge to the Waveney, at 7,500*l.* Capt. Smyth has already dredged a considerable portion of the channel, and his estimate for deepening the remaining shallows, including the Burgh Flats, is now only 3000*l.* App. B. No. 257.

These Burgh Flats have been formed by the waters of the Waveney and Yare meeting and forming an eddy, in which the soil is deposited; but it is believed that this may in future be prevented, if the channels through the Flats are dredged, and the projecting bank on the south side cut away, so as to direct the streams from each river slanting down the Breydon. The witnesses generally agree that the Breydon has of late years become shallower, and that it has a tendency to silt up generally, which renders it the more necessary to employ dredging to keep it open, and to preserve the reservoir for back water. A large portion of the north-east end of the area of the Breydon is dry at low water, whilst in other parts the depth varies from 10 feet in the channel to 3½ feet on the north-west side, but at high water the whole is covered with the tide to various depths. Capt. Smyth estimates the influx and efflux from the Breydon at the Bridge in ordinary tides at upwards of four and a half millions of tons; and as 1 foot depth of water over the whole area of 1,600 acres contains about two millions of tons, there would be at high tides twice that quantity for scour, if the stream was not throttled at the bridge, so as in ordinary tides to make the level of the sea on the Bar at low water 2 feet 9 inches below the level of the water in the Breydon. I was satisfied, by the soundings taken by Capt. Smyth on the passage up the river, that the chief impediments existing to the passage of sea-borne vessels from Norwich to the sea, are the Knowl Shoal in the Breydon, opposite the river Bure, and the shallow water at the Burgh Flats, and between the County Asylum and the Foundry Bridge. But all these may be easily removed. There are three or four ferries on the river Yare, where the jetties project several feet into the stream, and the ferry-boats, 30 feet long, are suffered to lie opposite the jetties, and thus to impede the current, and affect the depths in different ways.

These must be considered as encroachments on the channel, and should be immediately set back by the conservators of the river, so as to leave the stream as wide at each of these ferries as the continuous banks above and below them permit.

There are also many places where points of land project into the stream, and where sedges and grass impede the current, and both ought to be removed.

The banks of the Yare throughout its whole course present a series of projecting points and indentations, varying in breadth from 100 feet to 200 yards; the force of the current and the depth of the water also vary in proportion to the impediments to its course. In no part of the Yare was there less than 10½ feet, and in some places 19 feet depth of water.

These various impediments to the winding of the river stop the flow of the tide so much, that it is not high water at Norwich until five or six hours after it is high water at the Yarmouth piers.

At Reedham the Lowestoft company is preparing to erect a bridge across the Yare for the railroad to be made from Lowestoft Harbour to that place, to join the Yarmouth and Norfolk railroad, and that Bridge will constitute a new and considerable impediment to the navigation between Yarmouth and Norwich.

There is a communication by water from Lowestoft to the Port of Norwich, and there appears to have been no sufficient reason why a railroad running parallel to the water communication for the greater part of the distance should be also established. I greatly regret that the Admiralty should have given their sanction to so uncalled for an impediment to the navigation of the Yare at the time the Tidal Harbours Commission was inquiring into these matters. The Corporation of Norwich opposed the erection of the bridge in the year 1845, but as the Haven and Pier Commissioners of Yarmouth, the Conservators of the river, and the Admiralty gave their sanction, the Committee on the Bill refused to allow the Corporation of Norwich to be heard against the bridge, and thus a permanent impediment to the navigation of the Yare is now erecting there.

App. B. Ev. p. 509. The several bridges at Norwich also impede the flow of the tide and the navigation up to the mills, but within a few years the channel through the bridges and along the north of the city up to the mills has been deepened, so as to give facility to vessels of considerable size without standing masts to load and unload at the warehouses along its banks; and if the foundations of the buildings on each side of the river were secured by piles, the depth might be increased to accommodate the trade of the port.

App. B. Ev. p. 507. The Commission, on its arrival in Norwich, held an open Court in the Guildhall; and as the best informed persons attended to give information on the subject, reference must be made to the minutes of evidence for details.

It may be asked if the means of removing the obstacles to the passage of sea-borne vessels to and from Norwich by Yarmouth to the sea be, as has been stated, easy, why has that communication been so long delayed? The answer is, that the jurisdiction over the waters has been divided—that portion of the river Yare from Norwich to Hardley Cross is under the corporation of Norwich, and has been in a state to admit vessels of 150 or 200 tons to pass easily; but the portion from Hardley Cross, through the Breydon to Yarmouth, was under the Yarmouth Corporation until 1835, and has been under the Haven and Pier Commissioners since that year. The Haven and Pier Commissioners have always refused to deepen the Burgh Flats, and to increase the opening at the Yarmouth Bridge, which, by a literal interpretation of the several Acts of Parliament authorizing the levying of harbour dues, they ought to have done.

In the report on Lowestoft, the jealousy of the inhabitants of Yarmouth and their objections to admit Norwich to be a port, was assigned as the reason why the inhabitants of Norwich were compelled to make a harbour, by a new cut to Lowestoft.

App. B. Ev. p. 507. It was stated to the Commission, at the public meeting, by the town clerk and other persons, that at different times, great efforts had been made, and great expenses incurred by the city, to obtain a navigation for Norwich for sea-borne vessels, by the natural channel of the Yare, and the Breydon to Yarmouth. But it does not appear that the Corporation possess any records showing the several efforts made by them, as a corporation, towards obtaining a direct communication with the sea, either through Yarmouth or Lowestoft; at least no formal entries on the subject have been found in the books of the city; in fact, the Corporation were deterred from making any effort, by reason of the determined hostility of the town of Yarmouth, (which at former periods had been supported by the Haven Commissioners,) in resisting all the demands of Norwich, for a direct sea navigation between Yarmouth and Norwich.

Some of the inhabitants of Norwich and its neighbourhood, however, between the years 1820 and 1824, exerted themselves vigorously to obtain a communication with the sea, by sea-borne vessels, through Yarmouth, and made application to Parliament for that purpose, but they were strongly opposed and ultimately defeated, by the authorities of Yarmouth; and in 1826, despairing of obtaining the communication they desired by way of Yarmouth, they renewed their application to Parliament for powers to enable them, as a Joint Stock Company, to make a new harbour, by opening a communication through Lake Lothing to the sea at Lowestoft; and notwithstanding the strenuous opposition made by the town of Yarmouth, an
7 & 8 Vict. cap. 42. Act was obtained in 1827, for making and maintaining a navigation for ships and other vessels between Norwich and the sea, at or near Lowestoft, in the county of Suffolk.

That Joint Stock Company succeeded in making a harbour at Lowestoft, and a communication between it and Norwich by Lake Lothing, and a new cut from Oultan Broad into the river Yare was completed at an expense of more than 150,000*l*. Norwich by that Act became a port, but, from various causes, the scheme has failed; the Port of Lowestoft does indeed continue, but the class of sea-borne vessels, which the promoters of that navigation had in view, cannot pass, and therefore there is again a strong desire among the inhabitants to obtain a better communication with the sea, by way of the river Yare and Yarmouth.

Full information respecting this long protracted struggle will be found in the evidence taken by the Committee of the House of Commons, on the application for the Act, and printed by order of the House; it contains important information concerning the navigation of the Norwich rivers, and other statistics of the imports, exports, and tonnage thereof.

It ought to be observed that at the time the town of Yarmouth successfully opposed the project of connecting Norwich with the sea through that town; the state of the river from Norwich to the Breydon, and of the Breydon itself, was not so good for the purpose of forming a navigation for sea-borne vessels from Yarmouth to Norwich as at the present time, when the depth of water and other circumstances are much more favourable for the project. It is of importance to know what the intention of the Legislature have been, in respect to the improvement of the navigation between Norwich and Yarmouth, as shown in the several Acts, framed for that purpose; and the following extracts sufficiently prove that their object was to have the navigation fully and effectually cleared and deepened.

By the 9th and 20th Geo. II. dues were directed to be levied on imports into Yarmouth, and part of them to be paid to the Chamberlain of the city of Norwich "*to be applied for and towards clearing and deepening that part of the channel of the river Yare which lies between the new mills in Norwich and Hurdley Cross,*" and another part to be paid to the Mayor and Corporation of Yarmouth, to be "*applied for and towards the full and effectual clearing and*

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deepening of that part of the river Yare leading from Yarmouth to Norwich, called Braidon, in such manner as seven of the Commissioners shall order and direct."

12 Geo. III. c. 14.

By the 12th of Geo. III. c. 14 (1772) these powers were continued, and the Justices of the Peace for the city of Norwich were further required to appoint a skilful engineer to survey the river Yare, from time to time, from the new mills to Hardley Cross; and to order all encroachments, impediments, and nuisances reported by him, to be removed.

By the 25th and 39-40th of Geo. III., all the powers for collecting dues, and for applying them to deepen and render more navigable the several rivers emptying themselves into the haven of Yarmouth, were continued until 6th Will. IV. c. 49, when the present commission was appointed. The Norwich Commissioners have done their duty, and the navigation is in good order: but the Haven and Pier Commissioners of Yarmouth have not done their duty in deepening, as they should have done, the Breydon and Burgh Flats; and it is only since the Tidal Harbours Commission was appointed that they have directed them to be deepened.

If proper officers had been deputed, from time to time, to examine and report how far the intentions of the Legislature had been carried into effect, there might at this time have been a good navigation.

App. B. Nos. 255, 256, 257, 258

I must also refer to the reports of the several engineers employed at different times to examine the state of the navigation, and to give their opinion as to the best means of making Norwich a port. All of them admit the greater facility of making the communication with the sea by Yarmouth, if the Yarmouth Haven and Pier Commissioners had not so obstinately opposed it.

See Plan, p. 534.

A map has been prepared to show the general direction and extent of the inland navigation by the tide in the rivers BURE, YARE, and WAVENEY to the distance of thirty miles from Yarmouth by each of these rivers; it is stopped at Coltishall on the Bure, where the Aylsham canal commences, at the new mills at Norwich, on the Yare, and at Shipmeadow Lock above Beccles on the the Bungay canal commences: the rise of the tide at each of these places is different.

App. B. No. 256.

Mr. Telford in his report expresses a decided opinion that although "a convenient and safe navigation for vessels drawing 10 feet water may be made between Norwich and the sea by Lowestoft, yet from Yarmouth being an established port and the outfall of three considerable rivers," he recommends "that Norwich and Yarmouth should confer in a liberal and friendly manner how to improve the navigation between those two places so as to admit of vessels drawing 10 feet water; and all parties should cordially unite to render the improvements as perfect as possible, and considering the importance of the objects in view, the expense is comparatively inconsiderable." I concur entirely with that recommendation, which is at this time of greater importance than it was then. as Yarmouth is in danger of having its trade diverted to Lowestoft or taken away by railroads. Cordial co-operation will soon effect such an improvement in the natural navigation between Norwich and the sea by Yarmouth as shall benefit both places.

App. B. No. 257.

App. B. No. 258.

See Plan, p. 534.

Mr. Walker's special report to the Haven and Pier Commissioners in 1826 states very distinctly that the Breydon and the Yare could be made navigable with 10½ feet depth of water all the distance from Norwich to the sea at Yarmouth; and, lastly, Mr. Cockburn Curtis who, since the commission visited Norwich, has been employed by the Corporation of that city to survey and take the level of the river Yare from the pier head to the new mills, states, that he is decidedly of opinion that such a navigation can be both easily made and maintained. The reports of these gentlemen will afford all the requisite information in detail. Before I conclude I must call special attention to a clause in the Yarmouth Haven and Pier Act (the 5th and 6th Wm. IV. c. 49), which has placed great difficulties in the way of further improvement in the navigation of the rivers Yare and Waveney (section 35). It states that before deepening the Breydon and Burgh Flats, with the view of making the same generally navigable for sea-borne vessels to Norwich or elsewhere, an engineer shall be employed on the part of the commissioners to examine the state of the marsh walls adjoining the river, through which such intended ship navigation is to pass, and to report on the efficacy of the same, and that "*if the benefit to the marsh lands be not equal or commensurate to the expense of making such additional embankments, the owners thereof shall be entitled to require a compensation from the commissioners* from the duties hereby granted for the expense of making such embankments after taking into consideration the benefits, if any, accruing to the marsh lands."

App. B. No. 315.

Up to the time of this inquiry, no tide tables have been kept on either of these rivers, to enable us to judge whether the marshes on their banks would sustain more injury from the increased flow of the tidal waters, than they now do from the land floods, and the present insufficient drainage. But from the result of a register kept by order of the Corporation of the City of Norwich in December last, I am inclined to believe that the deepening of the channel of the river Yare and the Burgh flats, would so much increase the value of these marshes, by the improvement of their drainage, resulting from the general fall of the tide to a lower level, that the advantages derived would more than counterbalance the expense requisite towards raising the banks for the protection of these lands from the higher flow of any occasional extraordinary tides that might then occur. Considering that all lands covered by tidal waters are the property of the public, and that as such, they ought to have been preserved as highways for the public use, all proprietors who have been allowed improperly to encroach on the tidal lands, are for ever bound to protect their lands, as they did in the first instance, by embankments made at their own expense; and they are not, as stipulated in the clause of the Act alluded to, entitled to receive public moneys for that purpose; for, even admitting, which I do not, that, on the whole, injury would be done by the free entrance of the tide, I may ask whether it be just, that the people of Norwich, Beccles, and the adjoining districts should be called upon by any such stipulation, to pay for the preservation of lands which belonged origi-

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nally to the community at large, and were only through neglect allowed to be embanked by private parties for their own advantage? The embankments were encroachments and nuisances at the time they were made, and Mr. Justice Grose * declared that no lapse of time could sanction their continuance.

I will only add, that if there had been on the part of the public, any sufficient superintendence of the harbours and inland navigation of the country, such as is now recommended by the Commission, the dispute between Yarmouth and Norwich would not have continued, as it has done, for so many years, to the injury of the trade of both places, and with the expenditure of such large sums of money in mischievous contests.

If Commissioners had been sent by the Government to examine into the actual state of the navigation in Norfolk, and to report as to the best plan for meeting the wants of both towns, consistent also with the public interests, there is not a doubt that their differences would have been settled amicably and beneficially.

JOSEPH HUME.

BECCLES.

No. 16.

No. 16.

BECCLES PORT.

Mr. Hume's Report. 1846.

Report of the Examining Commissioner.

I VISITED Beccles, and held a public court, at which the mayor and other principal inhabitants and persons of all classes attended, and the evidence taken at the time will afford full information respecting the navigation and its existing impediments.

App. B. Ev. p. 516. The town of Beccles, having a population of 4086, has for centuries had a water communication with Yarmouth by the river Waveney, but the use of that navigation has been limited to barges of 25 tons by the shallow water on the Burgh Flats, and by the St. Olave's and Beccles Bridges, which cross that river.

App. B. Ev. p. 520. Neither the Commissioners of the Haven and Pier of Yarmouth, nor the Commissioners of Beccles Navigation, possess any survey or maps of the river, and therefore the information I obtained as to its length, breadth, and depth at different places, was imperfect.

It would scarcely be believed that Commissioners entrusted, under Acts of the Legislature, with the expenditure of money levied on shipping, specifically, "for improving the navigation of the river Waveney, and for removing all such impediments and annoyances as shall be found dangerous and hurtful therein," should have contentedly expended this money, from year to year, without having any survey or plans of that river made by any engineer to enable them to know where the impediments existed, or in what places the means at their command could have been best expended for the general improvement of the navigation.

From want of such documents, recorded from time to time, the present Commissioners have not the advantage which they would have otherwise derived from the experience of their predecessors, as there are no means of ascertaining correctly whether the navigation is improving or deteriorating.

The same observations apply respecting the rise and fall of the tides, and of the inland waters, for even at the present time there is not a tide-guage on any part of this river, to enable the Commissioners to know the actual rise of the tides, or of the inland waters, so as to estimate the natural advantages they might obtain by the application of the immense back-waters which they have at their command.

I must here further observe, that if there had been a Conservator of the National Navigation, whose special duty it would have been to have watched over the improvements of each harbour and river, and over the efficient expenditure of the moneys so hardly earned by our shipping, not only would the necessary information have existed in his office, but the impediments to the navigation stated in the Act of Parliament would most likely have been removed long ere this time.

See Plan, p. 534. It is stated that the distance by the river from the bridge at Yarmouth to St. Olave's Bridge is 9 or 10 miles, thence to Beccles Bridge 18 miles, and four miles further to the lock at Ship Meadow, the commencement of the Bungay navigation.

App. B. Ev. pp. 516 and 519. By concurrent opinion, the only impediments to the navigation of this river by sea-borne vessels from Beccles to the sea at Yarmouth, are the Beccles and St. Olave's Bridges, across the river Waveney, and the shallow parts of the Braydon waters, called the Burgh Flats, which extend only about three quarters of a mile. Those bridges are county bridges, and are considered by every person as nuisances to the navigation. The Beccles Bridge has three arches of 18 feet span each, and the centre arch, through which boats pass at low water, is only about 8 feet above the level of the water; and when the river is full from inland water, the opening is so small that boats are often obliged to wait 10 or 14 days before they can get through.

The water-way at St. Olave's Bridge is nearly the same; but the centre arch being one foot higher above the water, boats generally get through in the tide: but in land floods the arches are entirely filled up; and in some instances the adjoining marshes have been so much flooded by the obstruction of the bridge to the downward flow of the water, that boats have passed over the marshes instead of under the bridge.

Both these bridges greatly impede the flow of the tide upwards, and form perfect dams to the reflux of the tide and land-waters, obstructing alike the navigation and drainage of the district.

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* See Report on Wells Harbour.

It is stated that the tide flows by the Waveney for 30 miles up to Ship Meadow Lock, on which it rises in ordinary springs from one foot to 18 inches; at Beccles Bridge it rises about two feet, and at St. Olave's Bridge a foot more.

As already mentioned, no tide registers have been kept on this river, and therefore the exact difference of the times of high water between Yarmouth pier and the different parts along the river cannot be given with precision; but I was informed that the time of high water at St. Olave's Bridge is three hours later than at the Yarmouth haven mouth, and six hours later at Beccles. App. B. Ev. pp. 517 and 518.

According to the estimate of Captain Smyth, the shallow part of the Burgh Flats might be deepened for the sum of 3,000*l.*; and as the depth of water in the river generally exceeds 10, and in many places, 12 feet, the removal of the two above-named bridges, and the erection of others of a proper description, would open the navigation from Beccles to Yarmouth to vessels of 200 tons burthen, and give that town a communication with the sea. App. B. Ev. p. 519. App. B. Ev. p. 519.

As, however, the jurisdiction of the Yarmouth Haven and Pier Commissioners extends the whole distance of 30 miles, from Yarmouth up to Ship Meadow Lock, no improvement can take place without their sanction; and it is stated by the mayor of Beccles himself, one of the Haven and Pier Commissioners, "that there has always been a feeling of jealousy on the part (App. B. Ev. p. 516.) of the merchants of Yarmouth in regard to vessels going beyond Yarmouth Bridge, and the Commissioners of the Haven and Pier have thrown every impediment to their having a 44-feet arch at Yarmouth Bridge."

Although it is expressly stated in the present Haven and Pier Act (5 and 6 Will. IV., (5 & 6 Wm. IV. c. 49.) c. 49), passed in 1835, "that it would be of advantage to the navigation of the river Waveney if the bridge over such river, called St. Olave's Bridge, were taken down and a swing or balance bridge constructed in lieu thereof," and although power is given to seven of the Commissioners under that Act to remove the bridge, yet the nuisance has been allowed to remain, and to continue the injury to the navigation and drainage to which I have before adverted.

The Beccles and St. Olave's Bridges interrupt the navigation and the drainage so much, that they ought to be removed as nuisances by the counties of Norfolk and Suffolk, and then the deepening of the Burgh Flats would complete a navigation for sea-borne vessels between Beccles and the sea by Yarmouth, which I consider would be much more efficient and less likely to be interrupted than the communication that Beccles now has with the sea at Lowestoft.

The application of the Joint-Stock Company in 1827 to make Norwich a port, through Oulton Dyke and Lake Lothing, was supported by the Beccles Corporation, who desired to obtain also for Beccles a shorter and better access to the sea than they then had by the Waveney to Yarmouth; and Mr. Cubitt, C.E., was employed to survey and report to them on the practicability of sea-borne vessels coming up from Lowestoft Harbour, when completed, to Beccles.

On the 18th December, 1827, Mr. Cubitt reported that as soon as the Norwich navigation (App. B. No. 260.) to Lowestoft was completed, Beccles would in effect, without any further expense, become a port for sea-borne vessels drawing from five to six feet water, but that in order to obtain 10 feet summer depth of water up to Beccles Bridge, the Waveney would require deepening for about two miles at its upper end from Stanley Staith to Beccles Bridge, and he estimated that this might be done for 1905*l.*; he also stated that the other part of the Waveney, from Stanley Staith to the junction with the Norwich and Lowestoft navigation, was then from 10 to 14 feet deep.

In January, 1831, when the Norwich and Lowestoft Navigation was completed to the sea, there was a balance or surplus of 1748*l.* in the hands of the treasurer of the Beccles branch of the Yarmouth Haven and Pier Commission; and, as under the Act of Parliament, 12 Geo. III., c. 14, that money was expressly intended for the improvement of the navigation of the Waveney, it ought to have been applied to the carrying out the recommendation of Mr. Cubitt, by deepening the Waveney between Stanley Staith and Beccles Bridge, so as to complete the navigation between the sea at Lowestoft and Beccles for vessels drawing 10 feet water.

In the autumn of 1830, the Corporation of Beccles gave notice of their intention to apply to Parliament for an Act to make Beccles a sea-port, through Lowestoft; and an Act for that purpose (1 Will. IV., c. 50) was obtained by them in 1831. 1 Will. IV. c. 50.

It does not appear that there was any necessity for incurring the expenses of this Act, as under the 12th Geo. III., c. 14, the Commissioners had full power to deepen the river to the extent required, and the only new powers obtained, besides those of levying dues, were to make a cut to shorten the navigation. App. B. No. 261.

Before the Bill went into Parliament, objections were taken against the heavy expenses attendant on procuring an Act, when, as stated, the funds in the hands of the treasurer of the Beccles branch of the Haven and Pier Commission were sufficient, and ought to have been applied, to deepen the river Waveney, as recommended by Mr. Cubitt.

The result proves the soundness of these objections; for the proposed cut has not been made, and since the passing of that Act, 2,574*l.* have been levied as dues on the shipping (App. B. Ev. p. 516.) between Lowestoft and Beccles, of which sum 1,615*l.* were paid for the expenses of obtaining the Act; and only 16*l.* of the whole amount has been expended in "making the River Waveney navigable for ships and other sea-borne vessels, from Oulton Broad to Beccles," which was the ostensible purpose for which the Act was obtained. In fact, the accounts rendered show that the amount of the 2,052*l.* collected since 1831 from shipping has been absorbed in the expenses of collection and of obtaining the Act, except only the 16*l.* previously mentioned, and the remaining 506*l.* is invested in the Three per Cent. Consols, and, I am informed by the mayor of Beccles, is reserved to aid in defraying the expense of a new bridge proposed to be erected at Beccles.

It appears that the amount of Beccles port dues received in 1835 was 347*l.*; but that they

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had decreased in 1844 to 172*l*.; and further, that another Act of Parliament was obtained to enable these Commissioners to reduce the dues, which is an admission that the previous high tolls had injured the trade.

The heavy expense incurred in obtaining the Acts of Parliament for harbours is also an evil that should be remedied as soon as possible; and I strongly recommend that all Bills for improving harbours and navigable rivers should be considered as public Bills, and passed through Parliament in the same manner as the Turnpike Bills—free of expense to the promoters. In the case of Beccles, the navigation to the sea being completed by the Norwich and Lowestoft Navigation Company, no Bills were requisite, and the Commissioners ought to have saved the money wasted in procuring them for the improvement of the river.

Bungay Navigation.

During the Beccles inquiry, my attention was solicited to the state of the navigation of the Waveney from Beccles to Bungay, a subject which I consider to be strictly within the limits of Her Majesty's Commission, extending as it does to tidal and other navigable rivers.

The information I obtained in this case affords another instance of the serious injury sustained by many localities, and by the community in general, from the absence of a superintending authority over the rivers, as the navigable highways of the kingdom.

It shows that, under the present system, Acts of Parliament, made with the best intentions, for the public welfare, may either remain unexecuted, or if executed, may be perverted to the private interests of individuals, so as to cause not only great expense, but actual detriment to the locality for whose immediate benefit the Acts were intended, but loss also to the whole nation, by limiting its commerce and, consequently, its supply of seamen.

It appears that so early as the year 1682, an Act (22 Car. II., c.) passed for making navigable the rivers commonly called Brandon and Waveney: the object of that Act was to complete an inland navigable communication between King's Lynn and Thetford, and between Yarmouth and Bungay, by the rivers Brandon and Waveney, which, arising from the same head, at a place called Lopham Ford, divides the counties of Norfolk and Suffolk.

Previous to that period, the Brandon had been navigable by lighters and boats from the port of King's Lynn, on the west, to Thetford, and by the River Waveney, on the east, from Yarmouth to Bungay; but, by the silting up of those rivers, the Brandon, on the west side of the county, had ceased to be navigable beyond Whitehouse, about 15 miles from Thetford, and the Waveney, on the east side, no higher than the town of Beccles, being about 10 miles distant from Bungay. It is stated in the preamble of that Bill that the towns and neighbourhood of Thetford and Bungay had formerly derived great advantage from that navigation, and that both these towns and the surrounding districts had been reduced, from the ruin of the navigation and by the decay of trade and intercourse, to great poverty.

Commissioners were named in the Act, with power to appoint contractors to complete those navigations, and to fix rates for defraying the charges of the necessary works. Undertakers were appointed, and the navigation was re-established on the west to Thetford, and on the east to Bungay. It was the duty of the Commissioners to see that the navigation was efficiently maintained, and from time to time to regulate and fix the dues to be received by the contractors from the persons using the navigation; and also to hear and to decide upon all differences that might arise between the undertakers and the parties using the navigation.

Although the Commissioners were directed by the Act to appoint successors to those who died, they failed to do so, and eventually the Commissioners became extinct.

It appears that application was made to Parliament in the year 1751 to repair that neglect, and an Act was obtained for the appointment of new Commissioners for carrying out the Act of 22 Charles II., so far as it related to the appointment of Commissioners for the river Brandon; but no provision was made in that Act for giving those new Commissioners any power with regard to the navigation of the Waveney.

The navigation of the Brandon has been efficiently maintained under the new Act, though at a heavy expense, and disputes between the contractors for that navigation and the parties using it have, from time to time, been settled; but the Bungay navigation has, on the contrary, been neglected, and is now in so bad a state, that complaints are frequently made of the state of the navigation itself, as well as of the exorbitant charges levied on the boats that use the canal. There are now no Commissioners for the Bungay navigation to hear and decide on the grievances which the merchants complain of, as there are at Thetford, and the navigation, so important to that populous part of the country, has become, to all intents and purposes, a private property, and is transferred and disposed of as such; for although it is stated that the annual income derived from dues levied on boats using the Bungay navigation is about

App. B. Ev. p. 518.

1,400*l*. a-year, yet the amount expended in its repairs does not exceed 50*l*. yearly.

From a copy of the particulars of the sale of this Navigation a few years ago, it appears that lockage had been annually paid on about 18,366 tons passing that Navigation.

Especial attention is directed to the facts stated in evidence, of the heavy charge on goods; that whilst the freight of a last of corn is only 4*s*. from Bungay to Yarmouth, a distance of 40 miles by water, a charge of 3*s*. is made for the Bungay navigation of only 10 miles of that distance: and merchants prefer sending some of their goods by land carriage from Beccles to Bungay, to avoid the heavy charge on using that navigation.

It is obvious that Parliament, as it did in 1747, in the Brandon navigation, has the power of immediately applying a remedy to this case of the Waveney navigation, by appointing new Commissioners to carry into execution the provisions of the Act of 22 Charles II.

At a time when railroads are competing so strenuously with our coasting trade, it becomes an imperative duty not only to redress the local grievances pointed out in this case, but to

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improve the navigation, and to lessen the charges on goods as far as possible, so as to prevent the serious injury which must result to the nation at large by the decrease of the coasting shipping, which such heavy and unwarrantable burdens must occasion.

Joseph Hume.

Note.—By a letter from Mr. Gregory Faux, town-clerk of Thetford, it is stated that the navigation of the lesser Ouze is in good order, 13 miles from Thetford to Whitehouse; that the tidal waters from Lynn do not affect this navigation any further than Denver Sluice; that it is the property of the corporation of Thetford; that the revenue from tolls, in the year ending Oct. 1845, was 1728*l.*; that, in order to compete with the Norfolk Railway Company, the tolls on coals and coke to Thetford was reduced, on the 31st of March, 1846, from 1*s.* 6*d.* to 6*d.* per ton, and 50 per cent. on all other goods.

Lowestoft.

No. 17.

No. 17.

LOWESTOFT HARBOUR.

Mr. Hume's Report.

April, 1846.

Report of the Examining Commissioner.

I visited Lowestoft on the 4th of November, 1845, having previously given public notice of my intention; and, after viewing the harbour, I held an open court, at which the principal residents of the town and persons of all classes attended.

App. B. Ev. p. 322.

Lowestoft Harbour is an artificial one, and was opened by a Joint Stock Company in 1832, chiefly in consequence of the opposition made by the corporation of Yarmouth to the efforts of the citizens of Norwich towards establishing a communication through the Port of Yarmouth directly with the sea.

See Plan, p. 534.

The harbour itself was formed by cutting an entrance from the sea, through the beach, into Lake Lothing, from which the communication to Norwich was established by Oulton Dyke, to the River Waveney, and thence by a new channel cut to the River Yare.

At the time when this navigation was first completed, vessels drawing 11 feet water could enter the harbour and pass up by Mutford Lock to Norwich; but, from the want of back-water, and of the requisite repairs to the lock-gates, a bar has formed at the entrance of Lowestoft harbour, and Lake Lothing has considerably silted up, so that, at the present time, vessels of only five or six feet draught of water can use the navigation.

The Joint Stock Company executed the works at an expense of upwards of 150,000*l.*, of which 54,000*l.* were lent by the Exchequer Bill Commissioners in 1832 and 1835; and the annual revenue of the port being insufficient to maintain the works of the harbour and pay the interest of that loan, the Exchequer Bill Commissioners took possession of the harbour and navigation; and, after retaining it for two years, sold it, with all the powers under the Act, for 4,935*l.*

App. B. No. 267.

In examining the amount of the expenditure of the Company in carrying out their works, it appeared that the sum of 15,198*l.* was charged as the expense of soliciting and obtaining the Act of Parliament; nor is the amount of this charge to be wondered at, as from another return, furnished by the town-clerk, it is stated that the corporation of Yarmouth alone expended 8,090*l.* in Parliamentary opposition to the Bill.

The waste of these two sums of money, amounting to 23,288*l.*, is another strong proof of the necessity of putting an end to all such proceedings between local interests by making all Harbour Bills public Bills, and by the establishment of proper public officers, whose duty it should be, whenever disputes arise respecting navigation, to examine on the spot, and at the public expense, by properly qualified persons, into the merits of every proposed plan of harbour works.

It appears by the evidence that the harbour failed for the want of sufficient back-water to scour out the sand and shingle drawn in by the sea.

The bar often shifts with the wind, which blowing from the south, fills up the mouth of the harbour, while a north-westerly wind clears it out.

App. B. No. 264.

The witnesses think that the harbour might have been preserved, if the sluices at first established could have been kept in serviceable condition. But I have little confidence in that statement, and believe that it was destroyed from the want of sufficient back-water. The evidence and report of Mr. Cubitt, at that time, as to the efficiency of Lake Lothing as a back-water, has by the result proved to have been erroneous.

It is however known that the harbour, since its formation, has been useful on many occasions as a harbour of refuge to coasting vessels, and it is stated, that it has afforded great facilities for the saving of life and property from the vessels wrecked on the adjacent sands.

The Bill for the formation of the harbour was supported, and, I may add, carried in the House of Commons, mainly by the influence of the Naval Lords of the Admiralty, in the confident belief that it would prove a harbour of refuge, so much wanted on that part of the coast.

At that time I opposed the Bill, on the very ground that there would not be sufficient back-water to keep open the entrance; but I was not then aware of the large supply of back-water which might then, and may now be obtained from the River Waveney.

The jealousy of Yarmouth, to which I have previously alluded, seems to have operated so strongly in opposition to the establishment of Lowestoft harbour and Norwich navigation, that although the communication with the interior by means of the lock at Mutford was allowed,

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yet a special clause (No. 3) was inserted in the Act for the construction of this harbour and navigation, to prevent them from taking more water from the River Waveney than was absolutely necessary for the passage of the vessels through the lock, and this clause was inserted at a time when it must have been well known that all the lands above the lock around Bungay and Beccles were frequently subject to great injury from overflow by the land-floods, which the opening of the Mutford Lock at those periods would have materially lessened, while at the same time these land-waters, if allowed to pass through the lock into Lake Lothing, would, in their passage to the sea, have scoured and deepened the channel, harbour, and bar.

App. B. No. 268. I call attention to this important fact as worthy of the immediate attention of the Admiralty, who doubtless must desire to keep open and improve a harbour which has been constructed at so large an expense on so dangerous a coast, and must at times, if improved by that means, be highly useful to the trade.

App. B. No. 266. I did not find that any register, of the tide had been kept in this harbour, or along the line of navigation, and therefore requested one to be kept for a short period at Mutford Lock.

The register appended to this report, was kept for ten days, from the 6th to the 16th of November 1845, both days inclusive, from which it appears that the greatest range of tide, on the Lake Lothing side, was six feet five inches, and on the Oulton Broad side, one foot two inches. The average level of the water on Lake Lothing was 11 inches below the average level in Oulton Broad.

A special set of hourly observations was also made on the 16th of November, 1845, when the total range of the tide was six feet one inch; and from these it appears, that at Mutford Lock the level of low water in Lake Lothing was four feet three inches under the level of the water at that time on Oulton Broad; and that high water in Lake Lothing was 22 inches above the level of the water as it stood then in Oulton Broad.

Although these observations, made only at this one place, and for so short a time, are not sufficient to enable me to offer an opinion as to the exact amount of benefit which would result to the drainage of the lands above, and to the scouring of Lake Lothing and the harbour *below* Mutford Lock, yet they are sufficient to induce me strongly to recommend that a careful investigation of the subject should be made, both for the benefit of the parties in the locality more immediately interested and for that of the public at large.

I was informed by Mr. Stead, a merchant and maltster, at Beccles, that, at a time when his warehouses at Beccles were flooded by the land waters of the Waveney, which were prevented by Beccles, by St. Olave's and Yarmouth Bridges from draining off to the sea, the water stood several feet higher on the Waveney side of Mutford Lock than on that of Lake Lothing, and he applied to the Lock Commissioners to have it opened, and the water allowed to run off by Lake Lothing; but his request was however refused, and much damage was done to his property, and to the property of others, by continuance of the flood, which might, I believe, in that as in many similar instances, have been speedily removed by the adoption of the course that Mr. Stead had proposed.

The general ignorance of the importance of the powers of water, exemplified in this case by the want of registers of the comparative heights of the tides, as well as of the times of corresponding heights in adjoining rivers, shows the great necessity of extending to rivers the recommendation given in the first report of this commission, to provide for the keeping of tide gauges in harbours; for unless such a system be universally adopted, it must be impossible for any engineer to apply to the best advantage the natural powers of water that he may have at his command, to carry out the improvements that may be necessary.

App. B. No. 270. If a thorough acquaintance with the levels of water in the interior of rivers and harbours be so important for engineering purposes, a correct knowledge of the changes that may be taking place in sand-banks in the vicinity of harbours is equally essential. And a letter of Captain Washington, R.N., Admiralty Surveyor, in 1842, corroborated by the evidence of pilot Swain and others, more particularly points out the great changes that are constantly taking place on this part of the coast, and the necessity that exists for making frequent surveys and attending to all the requisite alterations in the situation of lights, buoys, and land-marks at present in use.

In conclusion, I would only express a hope that subjects so essential to the well-being of a commercial country, as those on which I have ventured to offer the above necessarily crude suggestions, will soon come under the mature consideration of the Board of Conservancy, whose establishment has been recommended by this Commission.

Joseph Hume.

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APPENDIX B.

No 1.

PORT OF DUBLIN.

APPENDIX B.

DUBLIN.

No. 1.
Evidence taken on the 10th Oct., 1845.

Examining Commissioner—Captain WASHINGTON, R.N., F.R.S.

Present:—The Right Hon. the LORD MAYOR, Alderman M'KENNA, Messrs GEORGE and HENRY ROE, Sir J. K. JAMES, A. HALIDAY, EDWARD M'DONNELL, JOHN CONNERY, JOHN WALSH, the Prussian Consul, besides other parties interested in the shipping of Dublin. The following evidence was given:—

Mr. HENRY VEREKER, Secretary of the Ballast Board, explained the constitution of the Board, as subsisting at present under the Act 26th Geo. III. He testified to the accuracy of the documents and returns of the Board transmitted by him to the Secretary of State, and asserted that no complaints against the state of the port had been received.

Mr. W. BIGGER, Ballast-master, submitted a copy of an account of the receipts and expenditure of the Ballast Board for the year 1844 This document was examined by the Commissioner, and information and explanations respecting its several items were given by Mr. Bigger and other gentlemen connected with the Ballast Board. The income of the Board appeared to be 34,000*l.*, derived from this port and the port of Balbriggan, for the improvement of which the dues are in part disbursed. Of these, under the head of Tonnage, 14,800*l.* were received during the past year.

It appeared from Parliamentary Returns that the receipts by tonnage dues in Dublin were—

	£.		£.
In 1820	9,731	In 1835	13,253
1825	10,542	1840	13,657
1830	12,475	1845	14,800

this continued increase having been produced, amongst other causes, by the increase in the size of the vessels that frequented the port. Under the head of Expenditure, it appeared, that in repairing the quay walls 900*l.* had been disbursed, and in building wooden wharfs 2,648*l.*, these having become necessary for the accommodation of vessels of a larger class, which could not lie alongside the quays. The total amount expended in improving the Dublin Docks, from 1841 to 1844, appeared to be 2,200*l.*

Lieut. HUTCHISON, R.N., Pilot-master, examined.—I have been acquainted with the port of Dublin since the year 1817. According to a survey of the port made 30 years ago, the depth of water over the east bar at low water was one fathom, and in the western channel, which was the best, a fathom and a-half. I was appointed Assistant Pilot-master in the year 1828, and Pilot-master in the year 1836. At the latter period, the largest vessels that could come up the river as far as the dock-gates were such as drew no more than 15 feet of water, and they were obliged to lighten before they could come alongside the quays. At present, vessels drawing 19 feet water come up to the same spot, but only those drawing no more than 16 feet can lie alongside the quays. Vessels drawing 20 to 22 feet have been brought this year to the Patent Slip Dock, North Wall. The ordinary rise of spring tides is 12 feet. In the year 1836 there was an obstruction in the channel between the Pigeon House and Poolbeg Lighthouse, which has been since dredged away. There are now 12 feet of water over the bar at low water. The increase of six feet has been caused by the channel having been scoured by the current which the great North-wall, built out into the sea from Clontarf, occasions. Steamers are obliged to stop until half tide. At present, at the south-west channel, the water is shallowest, where formerly it was deepest, which is owing to the current; but in the eastern part of the channel there is fine water. The channel is roomy enough for a frigate drawing 19 or 20 feet, up to the Pigeon House. There has not been any alteration of the position of the buoys on the bar since 1838. It is the duty of the harbour-master to superintend placing buoys to mark the channel. Two buoys are sufficient to define the bar, and another should be placed to show the deepest water. There is a perch at the end of the Great North-wall. I think that the extremity of that wall, which is now covered at high water, should be raised above high-water level, as accidents occur sometimes in consequence of its present condition. This, instead of excluding the tide-water, would deepen the channel, and remove the deposit within the Poolbeg Lighthouse called the "Mumbles." The sand-banks between Clontarf Sheds and the Lighthouse have been lessened since the building of the great North-wall. The depth of water outside the bar has decreased as the bar has deepened. There are now 24 feet of water on the Dublin bar at spring tides, and the facilities for navigation have been increased. There are some more buoys required on the south side of the river. I sound the river every year, and the soundings are registered on a chart, which is laid before the Ballast Board. The depth of water in the river from Carlisle Bridge has increased, which may be attributed to continual dredging. The tide is stopped by a weir called the Island Bridge Weir, about three miles and a-half above the city. Nothing could be done to diminish the expense of dredging the river except extending the North Quay-wall further seaward, towards the Pigeon House, so as to make a longer channel. Dredging could not, I think, be dispensed with, for if it were discontinued, the banks of the channel might fall in and choke it up. It costs about 3,000*l.* a-year. There is some deposit made in the river by occasional freshes. There has been no attempt made at deepening the river above Carlisle Bridge. It is not possible to sink the foundations of the quay deeper, or "under-pin" them, without danger of their falling; it could only be done with effect by rebuilding them. Graving-docks are much required in the port. There is one at Ringsend which admits vessels of 400 or 500 tons, but the want of such docks is complained of. The only place for the repair of large vessels or steamers is the patent slip at the North-wall. I think sheds on the quays where merchandize is loaded would be found very useful, as at Liverpool; articles liable to damage by wet are often left thereon in a torrent of rain.

APPENDIX B.

DUBLIN.

[No. 1. Evidence taken on the 10th Oct., 1845.

The COMMISSIONER read the following letter, which he had just received:—

"MY DEAR SIR,— *Custom House*, 10*th Oct.*, 1845.

"I regret very much that great pressure of business previous to my departure for England this afternoon will prevent me attending at the Chamber of Commerce this day. I was very desirous of doing so, as I consider I should be discharging a public duty by hearing my testimony to the readiness with which all suggestions and recommendations from this department have at all times been met by the Ballast Board and their officers. Many lighthouses have been erected, shoals and rocks buoyed, and, in fact, everything that could tend to the advantage of the country by the security of our shipping, has been readily undertaken by them whenever the subject has been brought properly under their notice.

"I could not refrain from leaving this unsolicited testimony to the valuable services of the Ballast Corporation.

"Believe me, very truly yours,

"*Capt. Washington, R.N.*" "JAMES DOMBRAIN."

Sir J. K. JAMES examined—Had been acquainted several years with the port of Dublin. There was not sufficient capacity of water for vessels entering George's Dock, and they were obliged to lighten. The sill was four feet above the level of the river. To lower the sill would be attended with expense. The deepening the river had been a general public benefit. An expense of from ten to twelve thousand pounds had been spoken of as necessary to remedy the defect complained of.

Mr. GEORGE HALPIN, C.E., Assistant Resident Engineer to the Board for 13 years, examined—He said, in reply to questions put to him by the Commissioner, that having already submitted to the Tidal Harbours Commission a full statement, accompanied by charts, it may now suffice to contrast very briefly the past and present state of the harbour of Dublin, as shown by those charts.

The first chart of note is that of M'Kenzie's Survey, in the year 1751. On it the depths in the bar channel at the low water of spring tides are marked as eight feet, and in the reach from the Pigeon-house to the quays as of two feet. The next public survey was that by Bligh in the year 1800. On his chart the bar is drawn as crossing the direct entrance to the channel of the river, having over it from five to six feet of water; and in the southern channel, depths of from seven to eight feet. On the Ford Bank, which is situate between Poolbeg and the Pigeon-house, the depth was only four feet; and in the channel, from the Pigeon-house to the quays, a depth of two feet; the soundings on all the charts denoting the depths at the low water of spring tides. Giles's Survey, made in 1818 and 1819, is the next of importance—it is minutely detailed and accurate, forming a standard with which to compare earlier and later surveys. On Giles's map as on Bligh's chart the ridge of the bar is drawn crossing the entrance to the Liffey, having on it from five to six feet water, and in the southern channel (which was then the principal one, and was narrow, circuitous, and leading close to the South Bull sand) the depth was eight feet. At the Ford the greatest depth was seven feet, and that only in a small passage close to the northern bank. In the reach from the Pigeon-house to the quays the general depths were from two to four feet; the irregular intervals of greater depth being then scarcely available for the purpose of navigation. Shortly after the date of this survey, in 1820, the northern pier, or Clontarf Breakwater, was commenced and completed in the year 1823. A systematic course of dredging was also commenced in the upper portion of the river, from which works the results have been most beneficial, and have been in progressive operation: those improvements are well shown in the Admiralty chart, made by Capt. Frazer, R.N., in 1838, from which it will be seen that in lieu of the former circuitous bar-channel a direct channel to the eastward has been obtained, in which the least depths at low water springs are from 11 to 12 feet; and not only increase of depth but considerable increase of breadth. In the channel at the Ford there is a depth of 11 feet, and there is also considerable increase of breadth. In the reach from the Pigeon-house up to the quays, formerly a large range of shoal, there is now a channel having in depth from eight to ten feet at low water. Between the quays the channel has been dredged nearer to the walls, and a considerable length piled, so as to admit of having the present depths of from eight to ten feet alongside, in portions of which the banks were formerly dry at low water. The depths stated are below the low water level, and the rise at spring tides being from 12 to 14 feet, it will be obvious that the river is now navigable at or before half flood by a class of vessels which formerly could not when laden have passed at high water. Such are the general results as respects the channel of the Liffey, shown by the Admiralty chart of 1838. The dredging has, however, since then been continued with marked advantage: and it is contemplated, so to persevere with the operations in progress, by widening and deepening the channel, that the river may be made navigable at low water by the greater number of the class of vessels trading to the port of Dublin. There are two steam dredges in the Liffey, one of 20 horse power, purchased 13 years ago, the other of 25 horse power, obtained eight years since; the soil dredged up is deposited at the back of the South Wall, in an enclosed space.

When he first became connected with the Ballast Board, the quays were built; they were built under the superintendence of his father, Mr. Halpin, and the Custom-house quay by the Revenue Board under the superintendence of Mr. Semple; they were made of granite; the vessels were smaller at the time the quays were built than those at present, and it was not contemplated that such deepening of the river should be made so near the upper reach of the river; they were not founded upon piles or rock, but were generally founded upon a bed which was sufficient for the river; they were from three to five feet below the bed of the river; the quays had given way in two places lately; the principal giving way was at the Custom-house quay, which was not built by the Ballast Board; he did not think it would be advisable to refound the quays; the interest of the money sunk would much more than maintain the timber quays; the lower portion of the timber quays would be but little injured in 50 years, and the upper portion could be easily repaired; Mr. Cubitt was consulted respecting these quays, and such was his opinion. 580 yards of timber frontage have been placed along the north quays, projecting from three to five yards.

There were only a few minutes difference between high water at the quays and the bar; at the North Wall there is a tide scale, which is registered daily, but there is no self-registering tide-gauge. The sill of the Old Dock was from four to five feet above the bed of the river. The width of the entrance, thirty feet; area, two acres. The tide rose from six to eight feet at neap tides and 12 feet at springs. It would be expensive to widen and deepen the quay. The sill of George's Dock was from three to four feet above the bed of the river, and the entrance 32½ feet wide. The Royal Canal sill is four to five feet above the bed of the river. Looking at the increase of the traffic of the

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Evidence taken on the 10th Oct., 1845.

port, he did not think it desirable to increase the width and depth of the sill at present; large steamers would not frequent the upper docks. A gridiron was a very useful thing for steamers, and one was about being constructed at the North Wall. The present patent slip was to be extended to nine feet low water springs. The quays at the south side were in tolerable order, and shipping frequented them, though not so much as at the north side. The Grand Canal Docks were not much used, a portion of the bank at the entrance to the docks still existed, but great inconvenience did not arise from that deposit of sand. The sill of the docks is from eight to nine feet above the bed of the river.

Mr. WALSH (Agent for Lloyd's) stated that almost all the colliers were forced by a regulation of the port to go to the south side of the river. There was also a large timber and mercantile trade carried on upon the south side. He conceived that fully three-fourths of the gross amount of shipping brought to the port of Dublin were discharged at that side of the river. His father had repeatedly complained of the mud on the south side of the river, and at the entrance of the Grand Canal Docks. On one occasion a ship came up in distress; was obliged to lay her alongside the quay and discharge; then had to warp back. Represented it to the Chamber of Commerce, got no redress. Ask the merchants of the city if complaints to the Ballast Board are attended to? Considered that the general opinion of the shipping interest was, that the port charges were enormous, and disproportioned to the advantages which were received. He conceived it to be his duty, as an agent for Lloyd's, to make this statement. He merely spoke of the Ballast Board in their corporate capacity. Individually he had received great courtesy and kindness from them. He knew an instance in which a person applied to the Board for permission to put up a "crane" at his own expense, but he would not be allowed to do so. An offer was made to him to put up a public crane, but not near his concerns. There was but one public crane, and that was in the Queen's Yard, and was used by the coast-guard; all the others were private property. Enumerated several highly respectable merchants, in order to show that they belonged to the south side of the river, and that there was more general trade done at the south side than the north side. The river was far from being dredged as it ought to be. A bank opposite the Marine School remained still as it was 30 years ago. Dredging was necessary even to allow the ferry-boats to move.

Mr. HALPIN remarked that there was not so much dredging upon the south side as upon the north side. He admitted that there was no dredging done close to the quays upon the south side, as it would not be safe to do so until the quays were under-pinned. Measures had been taken to enable them to dredge at the north side, and until the same was done at the south side it would be unsafe to commence dredging. It was intended to extend the accommodation upon the south side as fast as the means would admit.

Mr. WALSH said that great benefit had been derived from the improvement made in the port, both in the channel and on the bar, by the Ballast Board, but he maintained that the south side of the river had been greatly neglected. He also complained that they had no floating basins or graving-docks. They had fine sheets of water which were capable of holding large vessels, but they were so obstructed by mud as to be perfectly useless. Had known a vessel lying for six weeks, and could not get into the graving-dock. Another serious cause of complaint is the exorbitant charge for ballast, which leaves a large profit to the Ballast Board; and that supplied is not only bad, but endangers the safety of vessels. Among other instances, in the spring of 1845, the "Eagle," bound from Dublin to Quebec, had to put back to Cork after having been nearly 200 miles west of Cape Clear, owing to the ballast having by the working of the vessel assumed the consistence of mud, and thereby endangered the safety of the vessel and crew; and it must be remembered that it is compulsory on ships to take the ballast provided for them, and to pay 1*s*. 11*d*. a ton for what might be had for 1*s*. There are no sheds on the quays, and goods in wet weather receive damage in consequence; there is also a want of mooring posts, and great complaints are made of the manner in which the colliers are laid in tiers. The charge of ½*d*. per ton for the Poolbeg light (a local light), although small, becomes a serious tax on steamers, colliers, and coasters, especially as they have to pay two Dublin Bay lights besides.

Mr. M'MULLEN, the Secretary of the Grand Canal Company, observed, that a bed of mud was formed at the confluence of two streams, and this was the principal cause of the obstruction complained of.

Mr. HALPIN said, in reply to a question, that a reasonable application for a crane would be complied with, but the Board had an objection to sanction private cranes; that in June last it was resolved by the Board to erect a crane, and he had received the necessary instructions for the purpose.

Mr. POLLEN, Dockmaster to the Grand Canal Company, examined.—Within the Ringsend Docks, on the south side of the River Liffey, the depth of water was 17 feet; that on the lower sill of the lock leading thereto there were seven feet of water at low tide, and from 18 to 21 at high water; and it thus appeared, that any vessel which could pass over the bar could enter those docks; that the passage to the docks was, however, choked up by banks of mud, deposited by the Liffey and Dodder, at the point where their streams meet, and which formed a bar across the Liffey, requiring to be constantly dredged. That the Ballast Board had occasionally dredged this entrance, but imperfectly and partially; that vessels had frequently of late been delayed, and many prevented getting into the docks in consequence; that hand-dredging only was employed here; that the men employed did not appear to have received proper instructions, and were, in fact, doing little good, and refused to dredge at places pointed out by the Dock-master as most requiring it.

Mr. C. E. BAGOT stated that the dredging had been limited to the making a narrow passage to the dock-gates, whereas the whole of the reach of the Liffey, and the space in front of the docks, should be cleared out and deepened, to enable vessels to work their way, sailing or steaming, without risk of grounding on the mud-banks, particularly near the south-east angle, whence at present a bank extended into the channel.

Mr. C. W. WILLIAMS observed, that there was no use in deepening the entrance, inasmuch as the docks were so ill supplied with water as to be nearly useless, and stated that great delays and inconveniences had occurred in consequence; and that these docks admitted vessels for a few hours only of each tide.

Mr. C. E. BAGOT replied, that such was the case with docks in general, and in the London Docks particularly; and added, that it was part of the plan proposed by Mr. M'Mullen to obtain a larger supply of water if needed.

The DOCK-MASTER denied Mr. Williams's assertion, and stated there was always an abundance of

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water, never less than 16 feet; and that, whenever required, a sufficient quantity was obtained from the canal.

Some members of the Dublin and Liverpool Steam-ship Company dwelt on the importance and necessity to their purposes of the entrance being perfectly dredged and permanently deepened; and it was submitted, that the only effectual way to accomplish this object was to turn the Dodder more to the south, so as to discharge its waters behind the South Wall on the sands called the South Bull. The expense had been estimated at 3,200*l*. and 5,000*l*.

Mr. Sullivan objected that injury would be done to his property, and that the sands at Irishtown would be rendered unfit for bathing by the mud brought down by the Dodder; but it was stated that plans would be devised to obviate this.

Mr. Halpin remarked that the Dodder would stir up the sand, and that the ebb tide would bear it round the Poolbeg Light, into the mouth of the Liffey.

The Commissioner suggested that plans and drawings of the proposed new course of the River Dodder and Tidal Basin should be prepared by a competent engineer, and laid before the Lords of the Admiralty, who would give it consideration; and that, as each steam-ship company increased the amount of traffic, it would be desirable that every facility should be given to it, and he trusted the Ballast Board would apply the steam dredge to widen the channel into the docks.

Mr. Halpin said that the Board had ordered this to be done, and it would be done in about a fortnight. In reply to the Commissioner's question if something could not be done to obviate the necessity of dredging from time to time.

Mr. Halpin said that this could not be done without incurring an expense greater than would be required from year to year. He would not say but some project of an outer basin might not be devised, but no measure of the kind was at present proposed. The effect of the North Bull Wall had been to make a direct channel to seaward, and to deepen the eastern passage by removing six feet of sand. There had been a small deposit to the southward of Poolbeg, but it could be easily removed. One week's dredging would be sufficient to remove three years of deposit, and not only the deposit itself, but the tendency to it, was decreasing. The Ballast Board were making extensive improvements, and they were spending the funds to the best of their judgment, and as well as they could; that he was not aware of any intention to extend the line of wall, and if he were consulted he would strongly oppose such a step.

Mr. Charles W. Williams stated, that within his experience, which was very considerable, the harbour of Dublin had been so much improved that the greatest accommodation was now afforded to steamers, and accidents very seldom occurred.

The Commissioner said that this testimony fully corroborated what they had already heard as to the general improvement of the harbour.

Mr. Halpin.—The flow of tidal water in the river should, in my opinion, be augmented, as it would tend to deepen it. The Ballast Board have carried on operations to promote the flow of tidal water. There is a weir situated high up the river, which slightly impedes the tide, but it is not within the jurisdiction of the Board. I am also of opinion that the obstruction at the entrance of the Grand Canal should be dredged away.

Captain Alexander Donnell, one of the Harbour-masters of Dublin, stated, that he had held the office of Harbour-master of Dublin for 18 years. There was always sufficient berthage at the quays for vessels. There was a sufficiency of mooring-rings; he did not think sheds for merchandize on the quay were required; he had never heard of any desire being expressed for them, and the quay is a thoroughfare. There is a table of bye-laws and port-dues fixed up in the Ballast-office, but not anywhere else. Throwing ballast into the river is not permitted, and fines can be inflicted on those who commit any act of the kind. The muddy bottom of the river by the southern quay is not objected to; on the contrary, it has been found to be useful in the case of vessels taking the ground there. There is a sufficiency of buoys in the river. I can only recollect two vessels being wrecked in Dublin Bay; but I do not include under this term Kingstown Harbour. I take my orders from the Ballast Board, and make reports to them. I have no suggestions to make of improvements in the port; those which the Ballast Board carry on, by dredging, &c., are, I think, sufficient. The obstruction at the entrance to the Grand Canal ought to be dredged away; another steam-dredge would be necessary for that purpose.

Captain Duniam, Junior Harbour-master, did not think an additional steam-dredge was required. He would suggest that some posts should be fixed along the quays, as, during high water, the mooring-rings were covered. The parapet-wall along that quay was of some inconvenience to vessels, but it was necessary for the prevention of accidents.

John Glover, master of the brig "Massarene," said that room was very much wanted for vessels to moor on the south side of the river, at George's Quay, and also proper moorings.

Captain Scott stated that he had known the port of Dublin for 40 years. The dues were not so high as in other ports, though a little too high for the accommodation afforded. He thought a graving-dock the thing most wanted. There was no delay in unloading and getting ships clear at the quay. Some years ago the largest vessels that were employed in the timber trade were about 250 tons, but now vessels of upwards of 940 tons were employed in that trade.

Mr. Carson said, in reply to a question with regard to the port charges, vessels coming to Dublin were obliged to pay a charge of 4*d*. a-ton for Kingstown Harbour. He had early remonstrated against this tax, which should only be charged upon vessels that took refuge in Kingstown Harbour. The charges of Dublin were three—a charge of 6*d*. a-ton on colliers coming out of the harbour of Dublin; 1*d*. Quay-wall tax upon colliers; and a tax on foreign vessels of 9*d*. a-ton Irish. Irrespective of the charge he objected to, the port charges were light. The charge for lighthouses was a fair one, being value received by the owners of vessels which paid it.

Mr. James Carson said that there was one charge levied in Dublin of 1*s*. 11*d*. per ton for sand ballast, which was not so high in any other port in Europe. It was only 9*d*. a-ton in Liverpool. This charge was a grievance.

Commissioner.—The Secretary of the Ballast Board informs me that this charge is regulated by Act of Parliament.

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Mr. JAMES CARSON said he had to complain of another grievance. Once he had to pay 8*d.* a-ton duty on ballast that he removed from one of his vessels into another.

ROBERT MORTON, pilot, examined—There was a great improvement in the port, particularly as regarded an increased depth of water. Formerly they were obliged to lighten vessels to twelve feet water in the bay, and then they could only come up at high water; but now they could do so at half flood. He had brought up a ship drawing 19 feet of water, and of 995 tons burden, since the improvement in the channel.

Steam packets had grounded in the channel before the improvements were made in it. The "City of Londonderry" was lightened several times before they could get her down; but now steamers could come up almost at low water, or an hour's flood.

Mr. CARSON remarked that he expected a vessel from Quebec, which was of 1130 tons burden, and he had no doubt but she would come into the channel without any impediment.

The WITNESS continued to say that a beacon was required over the North Breakwater: they wanted a large permanent beacon. A ship, the "Agnes," was wrecked upon the North Wall for want of light about the year 1827.

There were two fog bells, which were bad, as they were not loud enough. They wanted a louder fog bell.

The COMMISSIONER inquired if it would not be advisable to use a gong instead of a bell, as on the coasts of England?

The WITNESS said that very few of the light vessels had gongs. He was only a river pilot. He never went as far as the Kish. He was not a sea pilot. There were 12 pilots upon the river, and 48 at sea. He was not sure there were so many as 48. He supposed that pilots were chosen after examination. Regular licences were given to them The buoys were very small. He went down the river 50 times, and never saw one of them. He made a representation to that effect to the Ballast Board, but the river was so much improved that now he regarded the buoys but little.

A bell buoy would be useful at the new North Wall, and he would have the bell at the Lighthouse, too, though the distance across was not more than three cables' length.

They did not derive much benefit from the bell in the Lighthouse. He would place a light between the North Wall and Poolbeg, a distance of three miles and a half.

Mr. CARSON said that with respect to sea pilots there had been a great improvement in them. They were now a class of smart and intelligent men, considering their standing; and it would be well if the Act of Parliament could be amended, and allow them to have British instead of Irish money, in which currency they were now paid. It was a fact that one-fifth of the amount allowed for pilotage was deducted from their income.

The COMMISSIONER said it appeared that this was required for the maintenance of the boat; but the suggestion should be attended to if there were a new Harbour Act.

The WITNESS next stated that in 1809, 1810, 1811, and 1812, vessels were lost upon the Bull, but since the North Wall was built, not one had been lost.

I was in the habit of earning 190*l.* a-year, but now I do not earn more than 100*l.*

Mr. HALIDAY.—Do you ever sleep out of your bed?

WITNESS.—Yes; I am often employed in looking for vessels upon the quays, but I never go out to sea.

Mr. HALIDAY observed that many sea pilots who were out all night, and had to perform very onerous and hazardous duties, did not earn more than one-half the sum earned by river pilots.

WITNESS.—He thought there were too many pilots; some sea pilots did not earn 2*s.* 6*d.* a-week: in Liverpool a pilot would receive 500*l.* a-year; and a pilot in Dublin, though he was obliged to endure greater hardships, did not get more than 60*l.*; he thought that one-fourth less sea pilots would do the work.

Mr. HALIDAY handed in the following document:—

COMPARATIVE STATEMENT OF THE PORT OF DUBLIN IN THE YEARS 1803 and 1844.

1803.	Tons	1844.	Tons
Largest vessel belonging to Dublin was the Columbus, owned by Furlong	309	Largest vessel belonging to Dublin—Jane Augusta; owned by J. Smith	948
The largest vessel arrived in Dublin was the Copernicus	406	Largest vessel arrived in Dublin was Jane Augusta	948
Of other vessels: arrived—		*Of other vessels: arrived—*	
4 vessels between 300 and 400 tons register.		10 between 300 and 400 tons register.	
1 only above 400, being the Copernicus, 406 tons.		10 between 400 and 500 do.	
		4 between 500 and 600 do.	
		1 between 600 and 700 do.	
		1 between 700 and 800 do.	
		1 above 900 do.	
Number of vessels cleared at Dublin	3,985	Number of vessels cleared at Dublin	4,492
Tonnage . . .	373,790	Tonnage . . .	610,092
Average tonnage of all vessels cleared at Dublin . . .	90	Average tonnage of all vessels cleared at Dublin .	136

Mr. MORGAN, one of the solicitors of the Corporation, observed that the right of the Corporation to anchorage and slippage had been, he understood, impugned. Now, if information were required touching the foundation for that right, he could produce it.

The COMMISSIONER said that, by charter, the Corporation levied 1,800*l.* a-year upon the shipping, and he wished to know what return was given for it.

Mr. MORGAN remarked that King John granted the charter, and by this instrument the sole ownership of the ground belonged to the Corporation.

Mr. J. CARSON said that he had to put his hand into his pocket to pay dues, and it was that most concerned him; and he hoped that in these reformed days, the Corporation would take this matter into their consideration and abolish those dues.

APPENDIX B.
DUBLIN.
No. 1.
Evidence taken on the 10th Oct., 1845.

Mr. MORGAN said he hoped that the community would soon be relieved from all things for which they did not get full value.

The COMMISSIONER observed that one of the objects of the Government was, to see the shipping interest protected as far as possible. It was his duty to inquire into the appropriation of money for which no value appeared to have been given, and he would request that this particular matter might be thoroughly investigated.

Mr. MORGAN said he could show that the Ballast Board emanated from the Corporation of Dublin, and a very rebellious child it proved to be.

The COMMISSIONER replied that it might be a rebellious child, but it had contributed much towards the improvement of the port of Dublin. He was desirous to know what the corporation had done for the port during the hundred years that they had had it under their control before 1786?

Mr. MORGAN said that the power had been taken from the Corporation, and if the matter were investigated it would imply a recrimination upon the part of the Ballast Board. The Corporation had always interfered to prevent fraud being practised in the coal trade. Since the power was withdrawn from the Corporation, the Lord Mayor was in the habit of visiting the quays for the purpose of superintending the sale of coal, and had succeeded in putting an end to the practice of selling by measure, which gave rise to fraud, and introducing proper weights and scales.

The COMMISSIONER repeated that he did not see why these corporate dues should be levied upon the shipping.

Mr. MORGAN replied that the right to the fee was founded upon the ownership of the port. The Corporation were the landlords and owners of the bed of the river. They had not done anything as regarded the shipping or cleansing of the river, for the power to do so had been taken from them 100 years ago by an Act of Parliament, the date of which was 1719.

Mr. WALSH then stated that the following vessels had been totally or partially wrecked, owing to the unprotected state of Kingstown Harbour :—

In the gale of March, 1844, from the 15th to 17th, with the wind from E. to S.E. :—

Collier Brig—Hemer, wrecked in harbour.
,, Mary ,, ,,
,, Tom ,, ,,
Schooner—Betties ,, old harbour.
,, Agnes ,, ,,
,, Belvue ,, ,,
,, Jane and Francis east pier.
Brig—Pandora ,, old harbour.
Sloop—Col. Smith ,, ,,
,, Catherine ,, ,,
Brig—Maria ,, ,,
4 total and 7 partial wrecks.

Gale of 4th November, 1844 :—

Barque—Kingston, }—Parted and grounded in entrance of old harbour, took fire and
Brig—Capricorn, } 3 total. [burned down to water's edge.
Schooner—Commerce, }
,, Hercules, }
Sloop—Busy, } 4 partial.
Susan, }
Wm. and Isabella, }

In his opinion the holding ground was good, but the harbour was unprotected and wanted shelter.

No. 2.
Dues payable to the Corporation.

No. 2.

ACCOUNT of City Dues, Payable to the Corporation of Dublin, on Vessels arriving in this Port, received during the years 1843, 1844, and 1845 :—

	Anchorage.			Slippage.			Lord Mayor.			Water Bailiffs.			Chapter & Guild.			Total.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
1843	641	19	5½	198	12	10	243	14	9	584	1	10	100	10	0	1768	18	10½
1844	657	17	0	202	18	1	243	12	5¼	383	16	3¼	99	3	0	1787	6	10
1845	689	13	4½	212	3	3	258	15	4¼	620	7	9½	107	8	0	1888	7	9½

No separate Account kept for Foreign Vessels.

Dublin, 2nd May, 1845.

W. B. PALGRAVE, Recr.

A RETURN of the Number of Vessels, with Amount of Tonnage, anchored in Kingstown Harbour, during the Year 1845. Her Majesty's Steam and Contract Mail Packets and Yachts excepted.

	Number.	Tonnage.
To and from the Port of Dublin, waiting wind and tide, sailing vessels .	981	106,883
Ditto ditto steamers . . .	136	37,631
From English, Irish, Scotch, and Foreign Ports, to Irish Ports	328	22,516
English, Scotch, and Foreign Ports, to English and Scotch Ports .	125	14,082
Irish Ports to English, Scotch, and Foreign Ports.	268	16,105
English and Scotch Ports to Foreign Ports	65	11,134
For Orders	33	3,572
To Kingstown	191	17,510
Men of War and Cruisers	87	..
Total	2214	229,433

MEMORANDUM.—Three Mail Steamers arrive and depart daily, not included in this Return.

W. HUTCHISON, *Lieut. R.N., Harbour Master.*

APPENDIX B.

DUBLIN.

No. 3.
Steam Packet Company's complaints of Pilotage Charges.

No. 3.

Complaints by the Dublin Steam Packet Company respecting Pilotage Charges.

24, *Walter Street, Liverpool,*
29th November, 1844.

SIR,

I have, on the part of the city of Dublin Steam Packet Company, to request, that you would have the goodness to submit to the attention of the Board of Trade the following statement on the subject of pilotage charges, which, in some ports, press heavily and unnecessarily on proprietors of steam vessels, and are felt to be particularly onerous at those ports to which the vessels of this Company trade.

The attention of Her Majesty's Government having been recently directed to the subject of port-charges throughout the United Kingdom, and that branch of it connected with pilotage having been already very fully investigated by a Commission appointed by the Crown in 1835, it is obviously unnecessary at present to trouble the Board of Trade with any lengthened statement of the reasons, which appear to the Directors of this Company as justifying the claim they now wish again to urge for relief from the compulsory employment of pilots at the ports of Liverpool and Dublin. It may be enough here to state that the Commissioners were so fully satisfied that the *frequency* of the passages of steam ships in and out of port (amounting, as they frequently do with the vessels belong to this Company, to four or five trips weekly) afforded such ample opportunity to the masters, officers, and crews, of becoming so thoroughly acquainted with the respective navigations, that they recommended in their report, presented to Parliament in 1836, that all steam vessels making passages not exceeding 24 hours' duration between one port and another in the United Kingdom, should be exempt from the necessity of taking a pilot on board, provided that one of the officers belonging to such vessel had passed an examination as to his competency before the (proposed) Commissioners of Pilotage.

This recommendation, somewhat modified, was subsequently embodied in a Bill brought into Parliament by the President of the Board of Trade, in June, 1838, but which, unfortunately for the interests of the owners of steam shipping, did not then pass into a law.

In the port of London it is *optional* with the commanders of *all* vessels in the coasting trade to employ licensed pilots or not, as they may find occasion. In other ports, as Dublin and Liverpool, this option is limited to *certain classes only* of coasting vessels; in all cases, however, it may be fairly presumed that it was the intention of the Legislature, when passing the several Pilotage Acts, to exempt from liability to pilotage charges those owners or masters of vessels, who from their frequent passages had become thoroughly conversant with the navigation, and therefore, in fact, did not need the services of a licensed pilot. And as the Commissioners of Pilotage, who sat in 1836, were decidedly of opinion that such should be the law, they accordingly recommended that all vessels in the coasting trade (including steamers) should be exempt, provided such vessels had on board as one of the officers or crew, a person properly qualified to conduct the ship in and out of port.

In the present state of the pilotage laws of the ports of Liverpool and Dublin, no vessels except those with *cargo* are obliged to take on board or pay for pilots; consequently, any ship employed exclusively in the conveyance of *passengers* is free to sail with or without pilots as the commander may consider advisable. Thus the vessels of this Company, engaged in the conveyance of cattle, flour, and merchandize, between the ports of Liverpool and Dublin, are liable to pilotage, while those employed in the conveyance of Her Majesty's mails and of passengers are exempt, and solely because they are without cargo.

It might well be argued that if pilots are not considered necessary for vessels with passengers only, they cannot be required by those with cargo.

I beg to add, that the vessels of the Company carrying the mails under contract with the Lords of the Admiralty, which are not required to take licensed pilots, are all provided with *skilful pilots as part of the ship's crew*, whose competency to perform the duty may be considered as sufficiently proved by the fact of the uniform safety and regularity with which the public service has been performed since it was entrusted to the Directors in the year 1839.

Again, it was given in evidence before the Committee of the House of Commons, that whilst by the pilot laws of some ports it is compulsory on owners of steam vessels conveying cargo to pay for pilots, their services are considered not only so useless, but even so objectionable from their ignorance of the proper management of steam vessels (as distinguished from sailing vessels), that they are generally rejected by the commanders of steam vessels.

I would desire, therefore, respectfully and earnestly to draw the attention of the Board of Trade to the defective state of the pilotage laws at present in force, and especially to those of the ports of Liverpool and Dublin, begging leave at the same time to suggest, that those defects would be effectually remedied by the enactment of a law similar to the Bill of 1838, which, while it proposed to grant relief from a very oppressive charge in cases where the service was actually not only useless but *mischievous* and *dangerous*, at the same time more amply provided for the general public safety, by not allowing the benefit of exemption in any case, except such as should appear reasonably entitled to it, from the fact of having on board the vessel, as one of the officers or seamen, a person whose qualifications to conduct the ship with safety in and out of port had been certified by a court of examiners.

I have, &c.,
WILLIAM WATSON.

To the Secretary of the Board of Trade.

No. 4.
Hutchison on the Pilot Establishment.

No. 4.

Lieut. HUTCHISON, R.N., *on the Pilot Establishment of the Port of Dublin.*

Kingstown, 9th March, 1846.

THE sea pilot establishment of the port of Dublin consists of four pilot cutters, of 44 tons register, having a master, mate, seven pilots, and two apprentices to each cutter. There are nine river pilots, who, with the assistance of three sea pilots, sent up monthly, pilot into the bay the outward-bound vessels; as the river pilots vacate from age, they will be replaced by sea pilots, so that ultimately there will be but one service.

The river pilots' wages average about 120*l.*, and the sea pilots 60*l.* per annum. The master of the pilot cutter receives, in addition to his share as pilot, 20*l.* a-year salary, and a cottage for his family; and the mate 6*l.*

APPENDIX B.

DUBLIN.

No. 4.
Hutchison on the Pilot Establishment.

Everything has been done by the corporation to improve the condition of the sea pilots; their cutters well found, their wages paid weekly in advance, and all their comforts attended to; and they have a sick, a clothing, a superannuation, and a widows' fund. But to further improve the service is not possible, until the rates of pilotage be altogether revised; the present rates are attached by a schedule to the Act of 44 Geo. III. c. 47, and an inspection of them will show the erroneous system under which they were framed, so as to induce the pilots to go any distance from the Bay of Dublin. A British vessel from foreign parts, from outside the banks to Dublin quays, pays 4*s*. per foot; from inside the banks, 3*s*. per foot; from the bay, 2*s*. 6*d*. The limits of the cruising ground are from Rockabill, near Skerries, to Wicklow Head. Coasters and steamers pay 1*s*. 6*d*. per foot less. But although the limits are properly extended, they are seldom found any distance from the bay, because they are entitled to outside pilotage at Bray Head, and when between Kish Light and Baily, at Point of Howth Head, both within the banks, when they should be leagues to sea. My opinion is, therefore, to fix the rates of pilotage, and give distance money, the only way to induce men to offer themselves to strangers approaching our coast, when their services would be valuable, and would give them 5*s*. or 6*s*. per foot outside the banks at Wicklow Head and Rockabill or Lambay, and but half that sum inside the banks. Also, in violent gales of easterly wind, when boarding large vessels in the bay, driven for shelter to Kingstown, they should be fairly remunerated for this service; they now only receive 1*s*. per foot from coasters, and 1*s*. 6*d*. per foot from British vessels. From foreign, or from seventy-four gun ships, the law precludes any increased demands, and masters and owners will not give more than legal payment. The pilots run imminent risk of their lives in boarding from the cutter, and are most inadequately paid, and no inducement held out to brave the sea, and render invaluable service from their knowledge of the state of the anchorage in the harbour, and what sail to keep on the ships to bring them to in the most sheltered situations. I have known a pilot boat to remain out in a frightful sea, and successfully board three large ships, all from foreign bound to Liverpool, but driven by stress of weather to Dublin Bay, and whose masters were perfectly ignorant of the harbour, and all the pilotage paid for these three vessels was 3*l*. 10*s*., when the masters should have been generous enough to pay 5*l*. each, and would have willingly paid double that if it were optional with the pilot to demand it on such occasions.

It is fruitless to expect zealous and adventurous men, except pilots are liberally paid. The sea pilot is not paid what he individually earns; a fifth is deducted by the corporation for the keep of the cutter, (which it is fair to say does not liquidate the outlay); the remaining four-fifths is divided into eleven shares: so that if a pilot takes charge of a frigate or Indiaman, worth 50,000*l*., and drawing from 20 to 22 feet water, his individual share is only 4*s*. out of 2*l*., her pilotage. My opinion is, that every man should receive the whole of the sum due for such a vessel, minus the fifth for keeping up the cutter. I am sure it would have a good effect, and insure better conduct. The charges are still continued in the old Irish currency, which reduces every pound one-thirteenth.

From my experience of the present working of the pilot service, it is neither sufficiently remunerative to induce educated men and good seamen to remain in it, and vessels that really require and anxiously look out for a pilot, do not obtain them on approaching the banks, and not until they reach the Kish Light or Bray Head, and most commonly, when most required, in thick weather, only get one in the Bay of Dublin.

WM. HUTCHISON, *Lieut. R.N.*, *Harbour Master.*

No. 5.
Extracts from Page's Report on Dublin Harbour, and proposal for raising the bar above water.

No. 5.

Extracts from the Report of Sir T. HYDE PAGE *on Dublin Harbour, and his proposal for raising the Bar above water.*

GENTLEMEN, *Dublin, 28th November*, 1800.

I have already approved of a second wall or bank on the north side of the river Liffey as a proper work, but observed that great caution in fixing the extent and direction was necessary. It will, I conceive, be of great advantage in confining the course of the water to one channel, and in preventing ships from being forced from their anchors upon the North Bull. It is, however, of the most serious consequence to be perfectly aware of the ill effects that would follow the execution of such a work, if carried too far towards the bay. It is only necessary to observe the lodgement of sand upon the South Bull between the Pigeon-house and bay, in the way to the lighthouse, to foresee the danger; and as similar causes would have similar effects, another lodgement of sand would be formed across the entrance of the river, and be a far more destructive bar than that which now exists in the bay; but there certainly is an extent to which a north wall or bank may be carried without the smallest danger of bad consequences, and be of much benefit. The natural curved lines above the buoy of the spit of the North Bull in the Liffey, show exactly where the wall or bank should terminate, and those irregular curves also show the lines upon which it should be traced to afford the greatest advantage to the river. There are likewise some open spaces that should not be closed, which are marked upon a survey taken after the line had been carefully buoyed out. As this work would be merely to answer as an embankment, and not meant as a wharf or quay, I would recommend it to be done chiefly with fascines on the side towards the river, and also in the extreme part below Pool-beg, upon an easy slope, with a base in the proportion of three times the perpendicular, that ships, if forced from the bay against it, might receive the less injury, and the rough rubble stone should be chiefly used in the body of the embankment, beyond which there should be a similar slope, that the sea might pass over it without a sudden resistance during the execution of the work. In addition to this embankment, I am of opinion that a part of the bar in the bay might be raised above high water, by the means of fascines and stones, with some small old vessels filled with the same kind of materials, and sunk in the body of the work, to form an island, which would be attended with great advantages, by confining the currents to certain lines of direction and causing deep water. The island so formed upon the bar would afford shelter to the mouth of the river and Pool-beg against the east winds. I would commence this work near the east buoy of the bar, and carry it in a line towards the other buoy at the west end, but not more than 880 yards in length, leaving a considerable part of the bar towards the west buoy without any kind of embankment or obstruction, in the line of direction from the Muglins towards the present concave part of the sand to the northward of the spit-buoy upon the North Bull, agreeable to the lines marked in the survey. This work might be undertaken with safety, after some progress had been made in the embankment of the Liffey, and its good effects experienced. The present state of the Liffey is in many respects very bad, immense quantities of sharp stones being suffered to remain near the wharfs and quays, and also near the wall in the way of the ships which are liable to take the ground. This objection to the present state of the river has probably arisen from some want of attention to the established regulations of the port. The flukes of anchors belonging to ships in the Liffey are also very dangerous, from the shallowness of the river, and great injury is often done by them. The present great extent of this danger might be avoided, either by mooring small vessels without masts, as bulks, with single-armed

APPENDIX B.

DUBLIN.

No. 5.
Extracts from Page's Report on the Harbour, and proposal for raising the bar above water.

anchors backed in the usual way, or by proper mooring buoys for the purpose of ships making fast to them, whereby the necessity of the present way of anchoring in the Liffey would, at least in part, be avoided. The south wall between the lighthouse and the Battery should be better secured by a proper slope on the side of the South Bull, and the break-water round the lighthouse is also in want of a similar slope, as the sudden resistance of the sea by the perpendicular parts is dangerous to that building. This I have represented to the Ballast-Office Corporation, in consequence of their application to his Excellency the Lord Lieutenant for my advice.

Floating docks some years since were thought to be absolutely necessary at Dublin, and a very fine work of this description has been since finished at a great expense. It is, however, very little used, which probably may, in a great degree, be owing to the want of a tide entrance basin before the ship-locks. There is sufficient space between the docks and the Liffey for a proper basin, and the addition of such a useful work would effectually prevent ships from lying a-ground in their way to the floating docks, and cause their advantages to be better understood than they now seem to be. The North Lots, near the Custom-house, is also a favourable situation for similar docks, and works of that description were commenced some years since by the Royal Canal Company.

No. 6.

Report by Captain WILLIAM BLIGH, R. N., *on Dublin Harbour.*

No. 6.
Bligh on the Harbour.

GENTLEMEN,

Dublin, 12*th Jan* 1801.

In answer to your letter of the 2nd of October last, in which you did me the honour to express your satisfaction at my arrival from England, and stating the desire of Government that I would make an accurate survey, and take the soundings of the harbour and bay of Dublin and the adjoining coasts, and lay down an accurate chart thereof upon a large scale, with observations upon the tides, currents, and winds, and their effects in respect to the navigation of vessels to and from Dublin; the information which such a chart would give being requisite to the forming of a decided judgment of the extent and position of the several works which may be in contemplation for the improvement of the harbour, pointing out where, with the assistance of art, vessels may find shelter in bad weather, especially when the wind is in the eastern quarter, or when by contrary winds, or the want of sufficient water over the bar, they may be prevented from getting into the harbour. That I would extend my examinations to the sand-bank called the Kish, and to any other shoals which lie in the approach to the harbour, and particularly to examine the bar, and the nature of the materials of which it is composed, that some judgment may be formed of the practicability of removing that obstruction to our navigation, and of deepening the channel and the immediate entrance of the harbour. And to state whatever may occur to me as likely to be of advantage in improving the harbour, assisting the navigation, or affording shelter and safety to vessels, under circumstances of distress or hazard.

I have now the satisfaction to communicate to you, that notwithstanding the unfavourable and tempestuous time of the year, I have accomplished your extensive requests; and that as in the execution I have been directed by great zeal and regard for the welfare of the city of Dublin, so in the result I trust and hope that my labour will be productive of accurate reasoning, and the foundation of eligible and good plans for its future advantage.

The map which I herewith present to the Board is a regular survey, on 4 inches to one English mile; it is laid down by magnetic bearings, not that I preferred doing so, but because I had not at the beginning made observations to ascertain the variation of the magnetic needle, which I have since accomplished, with observations for the latitude of the respective situations where I observed. The survey must prove itself: it requires nothing on my part to say of it.

In order to answer fully the wishes of the Board, and to render my account of what I have done distinct, I shall first take a general view of Dublin Bay as it now is, under distinct heads, and then give my opinion what is the most likely way to improve its navigation.

If anything requires further explanation, it will at all times be given with the greatest readiness and pleasure by

Yours, &c.,
W. BLIGH.

To the Honourable Directors-General of the
Board of Navigation, Dublin.

Of the Harbour.

The harbour, properly speaking, is the mouth of the river Liffey, limited by a wall on the south side S. 59 E. towards the sea, three miles and 286 yards long (measured by a straight line drawn from the Revenue Watch-house at Ringsend to the Lighthouse), and by the shore of Clontarf on the north, filled up with sand at low water, except a small channel near the wall irregular in its depths, and where very few ships can find a place to lie afloat at low water.

The mouth of this channel is marked by the Lighthouse as the south point, and at a quarter of a mile to the north by three buoys on a spit of sand, which dries at low-water spring tides. Between this spit and the west side of the bar, and to the north-eastward of the Lighthouse, there is half a mile of ground, which gives room to shipping to extend their tacks, and enables them to enter the harbour.

The mark to lead a ship to the south buoy on the bar is Coolock Church or the Lighthouse. There are at low water 3 fathoms one quarter of a mile south of the south buoy, then shoals to 9¼ feet where it lies, and from thence 7 feet is the least water, deepening to 15 feet very near the Lighthouse.

Irishtown Tower on to the Lighthouse leads to the east buoy, to which the water shoals gradually, and crossing the bar in that direction 5 feet will be the shoalest water, from whence going on to the Lighthouse the depths increase to 16 feet.

The deepest water lies round the Lighthouse, and almost one-third of the way over. I think, speaking generally, that there is 8 feet at the lowest tide for ships and vessels to guide themselves by in coming into the harbour. Now, if to this we add 8 feet for the smallest rise at high water, there is 16 feet; if we add 11 for the full moon, there is 19 feet; and if 14 for the spring tides, there is 22 feet at high water.

The shallowest water occupies but a very small space, and from a quarter of a mile to the southward of the Lighthouse, the water all over the bay deepens or shoals as you advance to or recede from the shore.

Near the Pigeon-house, there is a part which is shoaler than any place on the bar.

There are few places under like circumstances, that are so easy to be entered as Dublin Harbour. Its difficulties occur with an off-shore wind, which obliges ships to work in round the Lighthouse. A storm of wind south-easterly, to be sure, is tremendous; but, it is to be remembered, that with such winds you have more water, so that, in fact, the harbour is sooner ready to receive ships in such a situation. If the wind turns scant for getting into the harbour, the ship can then anchor with advantage in the bay.

With the wind moderate at south, or any way fair, not in the eastern quarter, for the harbour, and a ship after passing Dalkey is caught in a shower of snow or thick weather, which prevents her seeing the shore, they should then put their ship under a certain proportion of sail just so as to make her manageable, and allow them to get soundings correctly, and having so done, take their soundings from the Dunleary shore, from which they may round the edge of the South Bull Sand in the utmost security, keeping in the depth which, at the time this is doing, the tide is higher than low water; add to 9 feet the depth which the south buoy lies in at low water, and this will bring them in sight of the Lighthouse.

APPENDIX B.

DUBLIN.

No. 6.
Bligh on the Harbour.

If a ship is coming round Howth with the same weather and wind, to allow her the safest way is to steer over to the west-south-west, and do the same thing, edging off gradually to the north as the soundings direct.

What is here said respects merchant ships bound into Dublin Harbour; however, it may serve to direct others that may anchor in the bay, and all men-of-war of like draft of water which may be in distress.

In the night the same plan may be followed. At the south buoy I observed that the tide light could be just seen, therefore keeping it just discernible, so that there will be a thread of darkness separating it from the great light, you will pass close to the buoy; if you shut in the tide light, then you are steering into the westward of it.

I have thus given a description of Dublin Bay, so far as it is necessary for the safety of shipping. My map will particularly show men (if they will peruse it with these remarks, before necessity occurs) what they may do to avoid shipwreck, a calamity which will never be so well prevented as by early care and attention to this lead. Although shipwreck may become inevitable, it is necessary to struggle with it as long as we can, and then do the best, which in this place is to keep it off until high water, when on either of the Bulls the ship will be left dry, and the crew may leave her.

Of the Improvements in the Bay of Dublin.

Under this head, the advantage we are to look to is to have the harbour of Dublin easy of access, and to give the utmost security to the shipping, and it would be desirable to have a harbour on each side of the bay, so that ships in their course, up or down channel, meeting the wind contrary, should find a convenient place to resort to.

There is no advisable plan which can produce a harbour on the north side, but the south side does not altogether refuse it so directly, yet it promises no more than a dry harbour; it is all that can immediately be done for it.

It has Dalkey Sound, but this is so confined a place, with other disadvantages, that though something hereafter may be said of it, yet it is not our first consideration.

The possible expense which may attend improvements is of so much magnitude, and so closely connected with the success of what may be undertaken, that it limits in every mature consideration what should primarily be adopted, and must have that weight, if we mean to succeed, as to govern the project in proportion to the probable expense it will incur.

Likewise under this head, the time which it may take to accomplish any extensive plan is no trifling consideration, when the object to be accomplished becomes so remote in fulfilment that difficulties are likely to occur, and to counteract the original design; but, if under every disadvantage, we proceed with caution, establishing some real good, step by step, as we proceed, then where, or whenever we leave off from want of power to go farther, there remains a finish, which in works without these considerations would remain a wreck.

There is to be attended to as the principal part of our design the welfare of the city, and it is my opinion that should not be lost, even if a better harbour could be found in its neighbourhood; this, however, is not the case, and therefore the result of all my observations will, I hope, remove its difficulties as much as can be done, and promote its convenience.

But with whatever is to be done, there is, besides what it will cost to perform, to be considered it will require to keep it in good order and of use, and this, until there is some idea how it is to be supplied, should defer all proceedings on the work that is proposed, otherwise what we set about will turn to no good account; on the contrary, cause great expense to the community, the majority of whom are not so immediately benefited, admitting the plans are wisely designed, and successfully executed.

It is necessary for me, too, to premise that I consider all schemes as visionary, which pretend to cleanse Dublin Harbour by any artificial means except bodily labour, and any other way for ships going to Dublin to take but the present channel. I impress it strongly as a principle, that a canal and the Liffey would destroy each other, as both would be too burthensome to keep up, and that the general bias would at last go in favour of the latter. The canal would then become only a lateral advantage, and it would be very doubtful, if all the conveyances through it would ever repay the expense of making it, or even be sufficient to keep it clear, and at all useful for the purposes it would be applied to.

I shall now, with the utmost diligence, begin on the task which Government has desired me to undertake. And as I have, prior to this, in the preceding pages entered into a detail of the dangers, difficulties, and situation of places in Dublin Bay, I shall generally allude to those without digressing to explain any part of the opinion and plan I am about to lay down.

I propose, first, to make the harbour of Dublin competent to the trade it is possible to acquire; and, secondly, only to give it one good dry harbour in the bay.

The dry harbours, or anything but the harbour of Dublin, however, are only to be promoted when the Government can see that there are such means of keeping them up as that they will not be a burthen to the community; but that the expenses may be defrayed by a tax levied from the shipping, to be applied for that particular purpose.

If, after these two particular objects are acquired, the returns of commerce and wealth are such as to give spirit to proceed further, I shall, to meet that, be prepared with another plan, but which only, I think necessary to point out, may be put into execution whenever it becomes expedient.

It is a truth, that since the South Wall has been built all the way to the Lighthouse, the Bar (as it is called) has decidedly had a deeper channel into the harbour, near the Lighthouse, than on any other part, and this channel has gradually deepened.

It is a consequent truth, that there is now no bar to Dublin harbour, although shallow water at low tides; but this is no other than is to be found from the South or North Bulls, and you cannot on that account have deeper water than what is around you, do what you will.

There is the strongest and most evident proofs the point of sand, called the Bar, is disposed to remain where it is; that the ebb-tide passes over it without molesting the channel of the Lighthouse, and the deposit is carried to the east and north thoroughly out of the way of returning; and this will so continue as long as the South Wall lasts.

Under a firm conviction that the natural effect of the tide is now doing greater good for us than by any means we can devise with respect to preventing the sands really forming a bar across the harbour-mouth, I deem it best not to venture to change it by any means; but to receive it, and let it return as uninterruptedly as it is possible in executing what we purpose, which is to confine the river by a wall on the north side.

This wall is for two purposes—one of which is, to confine the sediment of the Liffey to itself, and limit the labour in keeping it clear; the other, to avoid whatever comes from Ballyhough and Clontarf. There is, however, a lateral advantage of some consequence: it will cause the water to rise higher in the river than when it was not confined; the flood-stream to be stronger than it now is, and ships will always get up in one tide, which I have seen they could not effect with a contrary wind.

Seeing these advantages, I propose that a wall shall be continued from the end of the present North Wall, at Ringsend, in a direction of a regular curve, dividing the water without giving the ebb any resistance or any inclination, but such as it has already; so that whenever the end of the wall permits it to unite, the junction may be as calm as possible, and pursue its present course towards the Bailey.

The termination of this wall may be anywhere within a point N.N.W. of the Lighthouse, if it cannot be completely built and finished. I have limited its extent to this, that the velocity of the flood may not be impeded or repelled abruptly, which would injure the channel; but its line of curvature should be the same as I have projected in my map, and for which reason only it is extended beyond the Lighthouse, to

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Bligh on the Harbour.

show that not the least interruption is to be given to the river-ebb. Thus the water of the Liffey and Clontarf will be divided without any sensible effect, but a benefit to the Liffey, in confining and deepening its harbour.

This wall being built, it will cause the stream to carry out a great part of the mud of the river, which comes down daily; but it is not to be looked for that it will clear it away altogether. No; what is at present in the river will not altogether remove by any means but by ballast-lighters; and the most essential duty that is due to the shipping and commerce is, immediately to employ a sufficient number of men to level the bed of the river. There should be at least fifty lighters and 350 men employed on this service, with careful overseers, and a regular register should be kept of their work. It is at present extremely grievous to see the state the shipping is in at low water. When the bed is levelled, they will lie fair on their bottoms, and not be subject to so much injury. It is the harbour that is to be complained of and not the bar.

The wall should be as high and as wide as the part beyond the Pigeon-house, and have at every 200 yards substantial rings or timber-heads; it should have no steps or slips projecting without the line of the wall, or anything to prevent the tide gliding smoothly down the river; by this means the velocity of the river will be increased, whereas, on the contrary, if it is made like the South Wall the tide will be materially obstructed.

The South Wall has such an irregular form, that it is of little service to the stream; but as a boundary, however, it will be of considerable advantage to the ebb, if the Pigeon-house basin wall is continued up until it joins with the other in a point.

I most earnestly urge here that some attention should be paid to the wall from the Lighthouse to the Battery; if it is not better defended about its base on the south-side, it may yet give way in some severe storm, but which may now be prevented by very little expense.

Building the North Wall and cleaning the river, therefore, are the objects to be acquired; the latter should be set about whether the former is or not. At present the ballast-lighters do injury to the river, and they will continue to do so until their numbers are increased and their work regulated; but when that is the case the harbour will become a delightful scene, and a security to shipping and commerce.

The water in the river will be always higher than at the bar; and I would recommend, that instead of the way they have now of estimating the tide, that a wooden pipe should be laid at the lowest water to communicate with a small basin, contrived for the purpose, at the wall of the Lighthouse, whereby the men might more correctly judge of the exact time to hoist the flag which denotes that ships may enter. If the flag is longer in being hoisted than it ought to be, whatever that is, is of material concern, and it is likely the men err that went out of fear of doing it too soon.

Among the various regulations which may be laid down for the river, there should be an express command that nothing should be thrown into it: and I think it would be an expense well bestowed to arch the mouths of the sewers, which, when the tide is out, are peculiarly offensive.

WILLIAM BLIGH, *Capt. R.N.*

[Captain Bligh also submitted observations relative to Howth, Dunleary, Dalkey, and Bullock.]

No. 7.

Captain CORNEILLE *on the Proposed Clontarf Wall in Dublin Bay*

No. 7.
Corneille on the proposed Clontarf Wall in the Bay.

GENTLEMEN,

September 7th, 1801.

In obedience to your instructions of the 20th of August, I have, notwithstanding the late tempestuous weather, very carefully examined that part of the Bay of Dublin described in the plan which accompanies this Report; and I am persuaded that the idea suggested by the Corporation, of erecting a pier or embankment, from the point of Clontarf Sheds to the Spit Buoy, would materially improve the entrance into the harbour of Dublin.

I believe that it is generally known, that the flood tide first makes at Sutton, then on the bar, and goes round the North Bull by Sutton Creek and the Spit, opposite the lighthouse, until it meets a little to the east of Ratheney; it then flows gradually over the North Bull until the whole of it is covered; so that the flood tide has a space of near seven square English miles to flow over loose sand as it fills our harbour.

I conceive that a vast body of sand is by that means thrown, in bad weather, upon the strand opposite to the Clontarf shore, and probably some into the river. Now, on the return of the tide or ebb, it has certainly the same room to go out, but as it falls from the North Bull, it forms a strong current between the Spit and the lighthouse, and that body of water, in rough weather, is full of sand and dirt, and, when checked by the bar, certainly deposits some filth upon it. I think also a quantity of sand is washed back upon the bar from the North Bull in the ebb tide, it being for the most part near its edge composed of loose land.

If then a wall was carried from the point of land to the east of Clontarf Sheds, in a right line to the Spit Buoy, and an opening left between its point and the present lighthouse of half an English mile, then the whole body of water required to fill the harbour must come through that opening, and of course the tide would, by that proposed wall, be prevented from flowing over the North Bull into the harbour.

I am sure by this proposed wall that the current will become very strong between the point of the intended wall at the Spit and the present lighthouse, so much so, that by disturbing and floating the sand which composes the bar at the strong ebb tide, great quantities of it will be carried away by that stream into the deep water—suppose only that one-eighth of an inch is removed in the twenty-four hours, the bar will be deepened near four feet in one year after the proposed work is finished.

There is a bank of sand called Rosbeg, lying near the Bailey, with five and six fathoms of water upon it, which (some of the pilot men with whom I have conversed with say) would, with the sand from the bar, be considerably increased, and perhaps form a second or worse bar; but I am inclined to think that it could not have that effect, as the ebb tide setting from the lighthouse to S.E., would carry that sand considerably to the southward of Rosbeg, into deep water of from six to eight fathoms.

Perhaps it may be said, that the strong current produced by the proposed work will destroy the wall itself. I myself think that in time it might injure it, as the wall would be a guide for the wind and water; therefore I propose to run a pier from the point of this proposed wall (marked B in the plan) towards the north wall, which would direct the body of water into the harbour; and I think (from the acute angle it will form) that a large body of sand and dirt will accumulate at the north side from the back water of three rivers, all of which are rapid in the winter season; but certain I am that no ship could be blown from her moorings in Poolbeg upon the North Bull, if this additional wall or pier is added—a consideration of the utmost importance.

Having now given my sentiments upon the effects which I humbly think will be produced by the proposed work, I beg leave to state that a great part of the wall must be built upon a running sand. It will therefore be necessary to use piling to some extent; and as the work will be much exposed to the easterly winds, which occasion the sea to have great power in that exposed situation, I propose to adopt a plan of Belidor's—that of a rough breakwater, composed of large rubble stones and furze matting, with an easy slope towards the sea, attached to a pier or wall, a section of which I have the honour to send, as also one for the additional wall, both of which, I trust, will fully explain the manner of constructing the proposed important works.

The estimate for a rough breakwater pier, or wall (marked A in the plan) is 16*l.* 10*s.* 4*d.* per foot; for pier (marked B in the plan) is 25*l.* 14*s.* per foot.

I have, &c.,

To the Directors-General of Inland Navigation.

CAPTAIN DANIEL CORNEILLE.

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No. 8.
Report of the Ballast Board on the improvement of the Port.

No. 8.

Report of the Ballast Board on the Improvement of the Port of Dublin.

SIR,

Ballast Office, Dublin, 13th October, 1801.

The Corporation for preserving and improving the port of Dublin have considered the subject contained in your letter to them, dated the 25th of August last, as secretary to the Directors-General of Inland Navigation; and I have now the honour to transmit to you, for their information, the general outline of that plan for the further improvement of the harbour of Dublin, which observation and experience have taught them to consider as the one most likely to tend to that point, and which is also, with respect to expense, the most within the bounds of practicability.

The objects which have been already attained by the completion of the south wall, appear to the Corporation to be the sheltering the harbour from the force of all winds to the southward, the preventing the influx of sand into the harbour with the tide from the southward, and the directing the ebb tide, much of which ran out heretofore over the South Bull, altogether through the harbour and towards the bar, which has already had the effect of deepening the harbour and south bar considerably; and as but a short period has elapsed since the completion of this work, the Corporation think themselves warranted in expecting that time will give a progressive increase to those last-mentioned advantages, namely, the deepening the harbour and the bar. The Corporation do not mean to give it as their opinion, that no farther improvement can be made on the south side of the harbour, but they consider the improvements already made there so complete, and the north side of the harbour to be still so open to wind and sea, as to have directed their attention of late altogether that way, in order to obtain on the north side of the harbour the like advantages which have already been attained on the south side.

In contemplating any plan for the improvement of the harbour, the Corporation have always looked strictly, and in the first instance, to the preserving and securing the admission of at least as much tide water which now flows into it, as is at all practicable, consistent with other objects. This they consider as of the first consequence towards ensuring the advantages which may be expected from any works constructed, or to be constructed or executed for that purpose, experience and observation having convinced them that from the reflux of this water, properly directed, they can alone expect the preservation and improvement of the harbour, for they are persuaded, that if the water of the Liffey were to be relied on for cleansing the harbour and deepening the bar, much disappointment and mischief would ensue, inasmuch as so far from its having power to effect those purposes, it is incompetent even to the carrying away a great portion of the filth of the town from between the north and south quay walls, a great quantity of which it deposits before it reaches the gut of Ringsend, and would in time render the river between the walls inaccessible to vessels which now frequent it, if it were not dredged from time to time.

But it is not enough that the flood water should find admission into the harbour: the ebb water should likewise be directed out of it with as great force that the attainment of other necessary objects will admit, in order that it may the more effectually cleanse the harbour and deepen the bar; and this the Corporation conceive is to be effected by confining the harbour's mouth, so far as is consistent with the safe and free passage of shipping into and out of it, an object in perfect unison with the plan which the Corporation mean now to point out for the further improvement of the harbour.

The works which have been constructed on the south side of the harbour are already complete to this object, as well as to the others which have been mentioned. The Corporation would now, therefore, call the attention of the Directors-General to the north side, where no works have been hitherto constructed, and to which, as they have already said, their own attention has been of late in a great measure directed.

The plan which the Corporation now recommend is the constructing of a wall, or other work, which should commence at or near the spot where the buoy of the Spit, nearly opposite the lighthouse, is now placed, probably with a work nearly similar to the lighthouse, and be continued to such part of the northern shore as may appear most advisable, both with respect to the quantity of water to be reserved within the harbour, to the direction to be given to that water in its flood and ebb, and also with respect to the line where foundations may be had most practicable and safe. This work will secure to the north side of the harbour like advantages with those already attained on the south side, namely, the sheltering the harbour from all winds to the northward of east, preventing the influx of sand into the harbour with the tide from the eastward, and directing the ebb altogether towards the bar and through the harbour's mouth. In addition to all which objects, this work will confine the harbour's mouth, and consequently the ebb of the tide altogether between the present lighthouse and its own eastwardmost point, which is precisely the extent of the deep water, through which alone ships can now pass into and out of the harbour, and by that means not only direct the entire tide water, part of which now ebbs and flows between the Spit and the dry part of the North Bull, through the mouth of the harbour, but also prevent the tide water from widening the space between the lighthouse and the point of the Spit, an effect which seems likely to be apprehended, as the increased force of the tide running in that direction into the harbour, since the completion of the south wall, has already removed the point of the Spit to some distance from the place in which it formerly was; and it is obvious, that if this effect should take place to any considerable extent, the force of the tide must be proportionably diminished, thus taking away from itself, both in its flowing and ebbing, a great portion of its sweeping and cleansing power.

The Corporation will just here observe, that it has been their object to interfere as little as possible with nature in the plan they have proposed, where its efforts appear to be usefully directed, but on the contrary—and this, they doubt not, an examination of the charts of the harbour will point out—to give it all due assistance; and further, that the work now recommended will receive protection and security from the works on the south side, which in their turn will receive the like advantages from the proposed work, each by this means not only carrying its own objects, but adding in a considerable degree to the value and security of the other.

In the progress, however, of the work now suggested by the Corporation, a consideration may arise, whether it will be desirable to run that work close up to the north shore, or whether an advantage to the harbour may not be looked for by stopping at some distance from it. The Corporation can never too strongly express their opinion of the value of the water which flows into the harbour with the tide, through the harbour's mouth, and which of course ebbs the same way; the North Bull, which has increased very much, both in extent and height, during the progress of the works on the south side, and more especially since their completion, is encompassed by the sea each tide; but to a spot on the north shore, nearly midway between the sheds of Clontarf and Baldoyle, the tide takes different directions: one branch runs in by Sutton, the other by the lighthouse, and having run round the Spit and the western side of the North Bull, through the gut of Clontarf, runs along the shore until it meets the Sutton tide at the point above-mentioned. It does occur, though seldom, that these two tides do not meet at all, but the water at the point of junction is never deep, and the tides seldom meet till very late in the flood. As is the flowing, so is the ebbing of those two tide waters: that which flows by Sutton ebbs by Sutton; that which flows by the lighthouse ebbs also by the lighthouse, running by Clontarf southward towards the block-house till it meets the main stream, and from thence eastward out to sea; now it is to be observed that a wall, such as has been proposed, would probably take that course, which, were it continued to the shore, would cut off a considerable part of the gut eastward of Clontarf into which the tide now flows, and from which it ebbs in the direction above-mentioned, and by that means necessarily excludes from within the harbour a body of valuable water. On the other hand, it may be observed, that the harbour cannot be said to be completely secured from the violence of the wind and sea until the wall shall have reached the shore. This object, however, may possibly be as effectually attained by running a work from the dry part of the Bull to the shore at the spot where the

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two tides meet, without at all affecting their natural course, and at all events it is a point which is likely to receive much elucidation in the progress of the work, and may, without any inconvenience, be left for future consideration.

The Corporation have now explained, as fully as is in their power, their general idea of that plan, which they consider as most likely to conduce to the preservation and improvement of the port of Dublin; a wall or other work extending from the eastwardmost point of the proposed work towards the eastwardmost point of the present north wall, but not so far as to join it, with opens in such work, to direct that portion of the water which flows over the north strand altogether through the present ships' channel, may at a future time become desirable, if it shall then appear that the natural direction of the tide will not be sufficiently pointed that way. But on this subject, and others of lesser consequence, the Corporation do not wish to hazard a very decided opinion. Time only can assist them in forming such, and to time they wish at present to leave the subject; they have confined their suggestions strictly to that work which, if executed, they think will be most useful to the harbour, and which they are persuaded is practicable, at an expense which will be abundantly repaid by the advantages which will be derived from it.

The works already executed by the Corporation have so far exhausted their funds as to leave them inadequate to the undertaking of that now recommended; should the means, however, of executing it, or any other work which they may consider likely to benefit the harbour, be put into their hands, they will endeavour to administer them in the most useful manner.

I have, &c.,
RICHARD BROUGHTON.

William Gregory, Esq.

No. 9.

MR. RENNIE *on the Improvement of Dublin Harbour.*

No. 9.
Rennie on Improvement of the Harbour.

London, 26th July, 1802.

DUBLIN being situated at the head of a shallow, sandy bay, over which the tide ebbs and flows for an extent of nearly two miles, its situation is as unfavourable for the making of a deep and commodious harbour as any of such importance which has come under my observation.

The Rivers Liffey and Dodder alone have enabled it to be made so good a harbour as it is; but when the extent of the sand and the smallness of the rivers are considered, it will be evident how inadequate they are to the formation of a good harbour, under the circumstances above stated.

Nature having been so sparing in her bounties, art has been called in to assist her in a greater degree, *i. e.*, to a greater amount, in point of expense, than in any other situation in the United Kingdom which has come under my observation; and, notwithstanding the immense sums of money which have been expended on the improvement of the port of Dublin, and which its inhabitants have been enabled to do by the liberality of the late Irish Parliament, it is still found very inadequate to the accommodation which the growing trade of the metropolis of Ireland requires; and unless it can be so improved as to render it much easier of access, and that vessels when they have got into it shall be in greater safety, the spirited inhabitants of Dublin will be prevented from sharing the commercial advantages of the British empire in the same degree as other situations which possess less internal productions than it does.

Before the end of the 17th century, the River Liffey had been confined to a regular channel through the city of Dublin; of course its water acting on a bed of given dimensions bad rendered the channel pretty regular and deep, but on passing a short distance to the south-east of the city, its course became meandering and divided into several channels through the extensive flat grounds and sands before described, and, like other rivers in similar situations, was liable to all the changes, both in direction and depth, which usually take place according as the floods from within, or the storms from without, prevailed. Ships, therefore, which frequented the port, were obliged to get up to the city by such channels as by the observations of the pilots were found to be the best.

The very bad state of the harbour, and the necessity of having it improved, gave rise to the establishment of the Ballast-office, which took place in consequence of, and according to, an Act of Parliament passed in the 6th year of the reign of Queen Anne, *i. e.*, 1707, which gave power to the Directors of the office to cleanse the Port and Harbour of Dublin, &c. &c.

From this period the regular works of the harbour took place, and they have been since carried on under the direction of the Ballast-office.

Whether the plans which have been pursued are the best which could have been followed, is not at present my purpose to inquire; suffice it to say, that their principle has been to direct the waters of the Liffey and Dodder, and the flowing and ebbing tide, in a straight line to the bay, by embanking them on each side as far down as Ringsend, and establishing works on the south side from Ringsend to the easternmost spit of the South Bull, expecting that by confining the flow of the river to the same channel as the tides, they would exert their force to the best advantage, and thereby deepen the channel and bar so as to admit ships of larger burthen coming to the city; and to effect this object more speedily, a channel was regularly marked out and ballasted by the gabbards, with such other assistance as the funds appropriated for the purpose would admit. This commenced soon after the establishment of the office; but a report having been spread that the harbour and bar had become worse since that period, soundings were ordered to be taken, which was done on the 23rd of April, 1711, and those who took the soundings reported that there were—

	Feet.
At the lower end of Poolbeg and Iron Pool to the Perch	30
At the Perch	30
A little below the Perch	from 27½ to 25½
From thence to the bar	21 to 22
Upon the bar	19 to 21
At the buoy of the bar	19

And about the year 1711, agreeably to a plan suggested by a Mr. Corneille, who was employed at the Harbour of Kinsale, and also in consequence of an opinion of Captain Burgh, His Majesty's Surveyor-General, a new channel for the river was made between the city and Ringsend. A work of kishes, filled with stone, was established on the north side of the channel, to prevent the freshes of the river from running over to the northward, and soon after a work of frames and piles was constructed on the South Bull to direct the channel on that side, and to defend it from the south-easterly storms.

While these works were going on, a proposal was made in the year 1713, by Captain John Perry (the engineer who was afterwards employed in the stopping of Dagenham Breach), for the improvement of the harbour. His plan was to make a low wharf or pier of drift-work from Irishtown to the outermost point of the South Bull, and to make a dam from the Ringsend to the high lands on the north side, to pen the water of the Liffey and Dodder to somewhat above the high water of a spring tide, with a stone sluice in the embankment to admit vessels into the basin. This plan does not seem to have been attended to, owing to some disputes having taken place respecting the election of a mayor and sheriffs for the city of Dublin, at the time Mr. Perry was there; he was, therefore, allowed to depart for England without any settlements being made respecting it. It seems, however, pretty evident, from the works which were afterwards carried into execution, that the low pier of drift-work recommended by him was the principle on which they proceeded. In the execution of this work considerable difficulties seem to have arisen, and

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the public opinion was much divided on the advantages which had arisen from what was done, and those likely to follow from an extension of them towards the spit of the South Bull. This gave rise to an order which was made by the then Lord-Lieutenant of Ireland, in July, 1725, that a map and soundings of the harbour should be made, and Captain Burgh, the Surveyor-General, and Captain John Perry, were directed to assist such persons as the Directors of the Ballast-office should appoint to examine the said harbour and channel, to take the soundings, and fix proper marks for the purpose of referring to in future, that a true state of the harbour might be ascertained, and to report their opinions whether any and what advantages had arisen from the works which had then been executed on the South Bull.

These gentlemen, assisted by a committee of Directors from the Ballast-office, and several merchants and masters of ships, made their survey and soundings on the 31st of August, 1725, and on the 17th of September reported their joint opinion to his Excellency the Lord-Lieutenant, accompanied by a plan of the harbour, showing the channel with its soundings and windings; wherein they say that they could not find any new gut or channel formed by the sea at the ends of the works carried out on the South Bull, excepting a very small hole at the end of the frames, which is constantly found at the end of the work after every winter, and had been as constantly filled up as the work was carried on; and they assure his Excellency that they found the channel generally deeper and several perches wider than it was at the commencement of the works.

Captain Perry, on the 29th of November, 1725, published an account of his method for making a safe and convenient entrance to the port of Dublin for ships of burthen to come up or go out by day or night at low water, without these hazards, loss of opportunity of winds, and difficulties they were then exposed to in their voyage, together with an estimate of the charges that was likely to attend the effecting of the same.

The scheme proposed by Captain Perry was, to construct a harbour at Sutton Creek, on the north-west side of the hill of Howth, by building a pier from the south point of the North Bull, of about 1,200 yards in length, parallel to the shore, and where the depth is about 13 feet at low water; and another pier from the main land opposite to its extremity of about 350 yards in length, leaving an opening of about 150 yards wide between this and the west pier, as an entrance to the harbour so formed. At the head of this harbour he proposed to construct a sluice, and to make from thence a canal, within the North Bull, along the Clontarf shore, for boats and gabbards to navigate to the Liffey, at Ringsend, having a weir or overfall from Ringsend to Clontarf Island, for the purpose of discharging the floods of the rivers Liffey and Dodder and the Ballybough stream. The whole of these works he estimated at 36,606*l.* This plan is very different from that he proposed in the year 1713, and must have suggested itself in consequence of his having seen that no great improvement could be expected from his former plan.

The above plan of the 29th November, 1725, was, by order of his Excellency the Lord-Lieutenant, submitted to the Directors of the Ballast-office for their consideration, and they were desired to acquaint his Excellency whether the method therein proposed was liable to any objections.

On the 11th February, 1726, the Lord Mayor, Sheriffs, Commons, and citizens of Dublin, in a letter to the Lord-Lieutenant, condemned the plan proposed by Captain Perry, and inclosed to his Excellency a Report from the Directors of the Ballast-office, dated the 5th February, 1726, and of which Report the following is a copy :—

Ballast Office Report in 1726.

"5*th February*, 1726.

"In pursuance to your request, we have not only some time ago, in company with Captains Burgh and Perry and yourselves, at Sutton, but also since, seriously weighed and considered the said Perry's new scheme for making an entrance into this port by way of Sutton, and we are entirely of opinion, that should the same be attempted (for allowing it to be finished, as proposed by him), would greatly tend to the ruin of our trade and navigation, for the following reasons, viz. :—

"1st. That the bay of Sutton, or the situation of the proposed pier, being in the north side of the bay, having on one side thereof a long and dangerous shore of rocks called the Hill of Howth, and on the other a large and dangerous sand called the North Bull, which make the entrance to said pier very narrow and dangerous, especially for any ships turning out, who, if once should miss staying, have not room to make a second attempt, nor room to wear, must in course go on shore either on the rocks or the North Bull, and consequently ship and cargo perish, and perhaps the men also.

"2nd. That with any wind from the W.S W. to the east makes at Sutton a very great sea, much greater than in any other parts, so that no ships can pretend to get out from thence with any wind from the east to the south-west, nor come in with any wind from the west to the north-east without warping; and suppose 50 or 100 sail should happen to arrive in one day, as often happens, would they not all require many days to warp in, and would not a continual damage attend to those ships striving to get in before the other? and the bad consequences may be feared to those who must remain without; whereas, ships with reef-topsails may turn in over the bar of Dublin with any wind; and, on the other hand, a ship from Ringsend, with reef-topsails, can sail out over the bar with the wind at south-by-east, which cannot be done out of Sutton by five points, so that all ships bound to the northward, which being about five times as many as bound to the southward, must sail into the bay with a contrary wind, there to wait for a fair one, and ships bound to Whitehaven, Chester, and even the packet-boats, must lie with the wind from S.S E. to the S.W., which is the best trading wind they have, and with which they readily can sail from our present harbour, and, with fair weather, have room to turn out with any wind.

"3rd. That with any wind blowing hard from East to S.S.W., there runs into the bay of Sutton a prodigious heavy sea, by reason of the depth thereof, and being confined to so narrow a breadth, and being more exposed to the open sea than in any other parts of the bay, would, in course, occasion such a swell and high sea between the pier-head, that no ships would feel their rudder going in, and of consequence under no command, so that it would be a mere chance if a ship could get in safe, but if they should happen to touch, it will be impossible that either men, ship, or cargo can be saved. But lay aside these difficulties, it is impossible that a ship of any draught of water can get within before the first quarter flood or last quarter ebb: for although in smooth water there may be depth sufficient, yet in hard gales of easterly winds there will be such a hollow sea; these will at least send six feet, so that a ship will of course stave her bottom out, and, being in extremity in the bay, and cannot wait for a tide, Sutton in those cases will be of no service, but, on the contrary, will prove fatal and of ill consequence to ships riding at anchor in the bay; and if the wind should come about from the N.E. to E S.E., and blowing so hard that a ship cannot ride it out, it will be impossible then for them to fetch Sutton; whereas, in our present circumstances, in such a gale of wind, a ship may get into Poolbeg, where both ship and cargo are safe.

"4th. That for at least eight months in the year the winds are generally observed to blow here between the S.S E. and west, by which winds ships must run a great way to leeward for Sutton Pier, and when they are there, that distance from thence (being above twice as far as from our present port), the passage very crooked and narrow, and in course those winds are full against them, which undoubtedly will make their passage up to town very tedious, to the ruin of ships and owners. Whereas, ships with all those winds may come in over the bar, and with the wind at S.S.W., can lay it up to Ringsend, and, if more westerly, can make a few trips, having room enough, and if in one tide or two, may get up to Ringsend, from whence they can get up on all occasions to the city.

"5th. That the harbour within the proposed pier head appears to us to be in a manner dry, or but little water in it, and that very narrow; what will then become of the many great ships that resort to this port of Dublin, as well as the men of war, who are not built to lie aground, nor cannot? That for these reasons, as well as many more here too tedious to mention, we humbly are of opinion that Captain Perry's schemes

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would greatly prejudice our trade and harbour. But that any improvement to the present harbour is the only means of safety for ships, and the future encouragement of our trade, that can be thought or invented, which, now lying happily situated in the middle of our bay, from whence ships equally may either go or come from the north and south, and we are entirely satisfied that the present work, to the general satisfaction, has answered the end, for ships of good burthens now daily come up to the quays, and the port below our harbour already becomes safe, and ships to ride by means of the piles or frame-works, and would the more be so was the scheme carried on with greater expedition towards the bar, and then should not doubt but that the bar would be deeper by the confinement of the land water running one way.

"6th. We can assure you there is at present as much water on the bar as ever hath been within memory; neither can we perceive any sands washed away from the South Bull, nor no spits nor sands driven inwards; only at the end of the piles a small sand is occasioned by the tide setting round the east end of the frames, which yearly goes along with the same, and in course will be open when the frames are carried into deep water; nor is the bounds of the outset of the land waters and the tides towards the bar no way widened, nor the stricts of the currents weakened, nor the depth of the water in the harbour any way lessened, but, to the contrary, deeper water is now at the upper end of Poolbeg. We are surprised at Captain Perry's wrong representation in all those particulars, as well as in his easy way of bringing ships into his pier and out, by which it appears he is no master of that branch; but perhaps it is not so as to the rest of his works, which we leave to your observations, as being out of our way.

"Lastly. We assure you that we have no other end, in what we here have offered, only at heart the good of this harbour and trade, being well wishers of the same, as we sincerely are."

In consequence of which Report the scheme of Captain Perry was totally laid aside, but they still continued the piles and framing on the south side of the channel; and on April 14, 1727, they reported that the bank on the south side of the frames had not risen so much as they expected, on account of the great tide running through Cock Lake, and that it would not answer expectation until the said lake was stopped; and, until this was done, the stability of the frames and piles would be very much endangered, and that they would require a constant expense to keep them in repair; and they recommended that not only the gabbards they then possessed and could spare from the shipping, should be employed in taking sand out of the channel to back the frames, but that two additional ones should be purchased for that purpose. In the year 1729 they reported, that in consequence of the works on the South Bull not being carried on so expeditiously as the same required, that the tide had made a deep gut at the east end of the frames, and carried a spit a great way into the channel, which was very inconvenient for the shipping, and that it would get worse if the carrying on of the frames into deep water was long delayed, and they recommended that application be made to Parliament for an Act to enable the Directors of the Office to raise a sum of money, not exceeding 3,000*l*., to finish the frame-work on the South Bull, so as to prevent the spits for the future. In August, 1730, an old vessel was ordered to be purchased and sunk at the east end of the frames, to secure them against the winter storms. In July, 1731, they reported that the bank on the west side of Cock Lake, in Salmon Pool, running to the southward, had become very high, and had only two feet of water on it in common tides, whereas, on the line leading to Ringsend, there was about six feet of water; they, therefore, recommended that the work from Cock Lake be carried upwards with a double dry stone wall, filled between with gravel; that this would make the basin within the bar larger and able to contain more water, and consequently, by the flux and reflux of the tides, would deepen the bar, which they already feared had been prejudiced by shutting the water out of the harbour, by the taking in of Sir John Rogerson's ground and the north wall.

These works were continued; and in October, 1734, they state that they had repaired some of the frames which were injured by the storms of the preceding winter; and that they had the pleasure to say that the new channel at the east end of the piles (formerly called the gut) extended itself wider, and had become deeper than the bar, insomuch that most ships going out and coming in chose rather to make that their way, being far more secure, as well as nearer into the port.

In October, 1735, a floating light was ordered to be placed at the east end of the piles on the South Bull. In June, 1742, the south channel adjoining the east end of the piles was sounded, and there was found in it at half ebb from 12 to 16 feet of water, and on the east channel, between the south channel and old bar, they found from 13 to 15 feet at half ebb, and at low water, on the bank at Cock Lake, only 2½ feet water, and in other parts of the channel, coming up as far as the hole at the north wall, from three to five feet.

The works on the South Bull and to Ringsend seem to have been finished agreeably to the plans formerly mentioned, namely, a double wall, filled with gravel, from the west side of the gut which led into Cock Lake, and nearly where the Pigeon-house now stands, and from thence to the east spit of the South Bull the piling and frames were established. It appearing afterwards that these frames and piles were frequently out of repair, and that not only the expense of keeping them up was very great, but that they did not sufficiently shelter the channel, they therefore came to a resolution of substituting a wall in their stead. This was begun in June, 1761, by building the stone lighthouse now standing at the east end of the south wall, and which was carried on afterwards from year to year till the whole was finished.

I have been thus particular in my historical sketch of the works which have been carried on for the improvement of Dublin Harbour, at a very great expense, during the last century, in order that it might appear what effect has been produced, *i.e.*, what improvement has taken place in the channel, and whether any, and what additional depth of water has been procured on the bar.

It appears from the soundings taken by order of the Directors of the Ballast Office on the 23rd of April, 1711, which was then at the height of the spring tides, "That there was from 19 to 21 feet depth of water on the bar at high water, and 19 feet at the buoy of the bar."

In a plan made by a Mr. Gabriel Stokes, in the year 1725, and on which the soundings taken by Captain Thomas Burgh and Captain John Perry are laid down, it appears that at a low water of a spring tide, there was 6½ feet of water at the buoy of the bar, and about seven hundred yards to the westward only 5½ feet. Now, as in ordinary spring tides the rise on the bar is 14 feet, it will appear, that in the year 1725 there was 20 feet water at the bar buoy in spring tides, and 19½ feet about seven hundred yards west of it. This agrees so nearly with these taken in the year 1711, than it cannot be said any alteration took place in that period.

In the year 1800 a map of Dublin Bay, comprising the soundings and sets of the tides, was made by Captain Bligh, of the Navy, by the orders of the Directors-General of Inland Navigation of Ireland; and from these soundings it appears, that there was only from 5 to 5½ feet water on the bar at the low water of an ordinary spring tide; and as several of these soundings were taken by myself in December, 1801, I have no doubt they are accurate. From this it appears, that at the top of a spring tide there is now only from 19 to 19½ feet of water on the bar, and this bar is exactly in the same situation, *i. e.*, at the same distance from Ringsend in Captain Bligh's map, as it is represented in that of Mr. Stokes.

By comparing the general soundings on the bar on Captain Bligh's map with those of Mr. Stokes, it appears a part of the south end of the bar has been worn away, and that instead of from 1½ to 2 feet of water, as represented by Captains Burgh and Perry's soundings, there is now on this side from 5 to 5½ feet. But this is all the advantage that seems to have been gained on the bar by an expenditure of upwards of 200,000*l*. But although this great wall has scarcely bettered the depth of water on the bar, yet it has been of considerable advantage to the harbour, by sheltering vessels in south-easterly winds, and enabling the channel up to the said harbour to be made of a more regular depth, and maintaining it in that state, than it formerly was.

From the little good that has been produced by the extensive works already executed in improving the

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depth of water on the bar at Dublin Harbour, I cannot say I have any very sanguine hopes of much good being produced by any works which can be added at a moderate expense. The scouring away of bars is but an uncertain operation at the best, and can only be done by bringing additional water to act on them, or by confining the action of what water there is to a narrower channel. The plan, therefore, that occurs to me as best suited to this purpose is,—

First. To built a pier from near the spit buoy of the North Bull to the Clontarf shore, about half a mile east of the sheds, leaving an opening of about 550 yards between its head and the south pier.

Secondly. To embank the South Bull, so as to enclose about 1300 English acres, statute measure, and to make a large opening in the south wall near the Ringsend (arching it over for the road) to admit the tide into this space or reservoir; or it might at times be admitted by the Dodder, and let out when there are no floods in that river, so as to extend its scouring power higher.

Thirdly. To make low jetties on the flat shore from the channel towards the Clontarf shore, to direct the water as well on the south as on the north side of the ship channel in one course, and both in the first quarter of flood and last quarter of the ebb, when its scouring power is the greatest.

The new proposed north pier, enclosing about 2500 statute English acres, over which the tide will flow to the average depth from seven to eight feet in springs, and the South Bull enclosure containing about 1300 acres, over which it will flow to the average depth of from five to six feet in spring tides, will cause about 36 millions of tons of water to ebb and flow through the mouth of the harbour in spring tides, which will pretty nearly double its present power of scouring.

Great, however, as this may appear, yet I am doubtful whether it will produce much effect in deepening the bar, for as the water has so much room to spread after it passes the pier heads (the distance of the nearest part of the bar from the lighthouse being nearly 600 yards, and its average breadth about half a mile, with from five to seven feet water on it at low water). I am of opinion, that even with all the assistance which can be given to it by ploughing or dredging the bar (which is composed of a hard small sand), not above a foot of additional depth of water will be got even by this great expense, which amounts to 232,384*l.*, as appears by Estimate No. 1.; and that the principal advantage which will be gained will be in the additional shelter to the shipping in the harbour. It appears to me that this is gaining little at a great expense.

If ever any considerable additional depth is to be made on the bar, it must be done by extending the present pier about 800 yards, and also building another from the south head of the proposed north pier, for about 1100 yards in length. These piers being placed as shown on the accompanying plan, will confine the water which is to flow and ebb through the entrance into the harbour, and that from the reservoir of the South Bull, to act with much more effect on the bar than by being left at liberty to spread after it has passed the present lighthouse; and if the bar is ballasted and dredged at spring tides, while the works are under execution, and for some time after they are finished, I have no doubt an additional depth of water of about three feet may be obtained The direction I have given to these piers will admit of vessels entering the harbour easily; and there will be quiet water within, even in storms with south-easterly winds, as the direction given to the head of the south pier will make the waves spend their fury on the Clontarf shore. The whole of these works, except the jetties, are represented in the Plan, No. 1.

The expense of these additions will appear by the Estimate, No. 2, to amount to 403,488*l.*, making a total of 635,872*l.* for the improvement of the present harbour, by which it is expected 3 feet additional depth of water will be got over the bar; *i. e.* there will be from 8 to 9 feet at low water spring tides, instead of from 5 to 6 feet, as there now is. There are several minor works which will require to be done should this plan be carried into execution. These are included in the estimates, although for the sake of brevity I have omitted the particulars in the Report, conceiving it will be sufficiently long without the relation of such minute circumstances.

The very great expense which any considerable improvement of the present harbour of Dublin will cost, with the small advantage which, comparatively speaking, will be derived, has induced me (as others who have preceded me have done) to consider whether any more eligible and more effectual plan can be devised at a less expense for the improvement of Dublin Harbour than what is here described.

For this purpose I carefully examined the north side of the bay, and round the Green Baily to the entrance of the harbour of Baldoyle, and also the south side, and round by Dalkey Island to Killiney Bay.

In this examination there appeared three situations worthy of attention, namely, Sutton Creek on the north side, and Dunleary and Sandy Cove on the south side. As to a harbour at Howth, in the sound between Ireland's Eye and the main land, with a canal to Dublin, it did not seem to me sufficiently inviting to warrant a very strict examination, as I am of opinion that no expense which could be laid out here would render the harbour permanently deep. The sound of Ireland's Eye, in its present state, is extremely useful. There is deep water round the whole island, and therefore if vessels can get to it in stormy weather, they will always find shelter in the wake of it. I am therefore of opinion that no money should be expended on this situation; and for reasons given in my Report to the Directors-General of Inland Navigation, dated the 24th of March, 1802, I am of opinion no money should be expended on the improvement of Dalkey Sound. The consideration will then, in my opinion, be, which of the three situations named within the bay will answer the best.

1. Beginning then with Sutton Creek. It appears to me the plan of the outer harbour, proposed by Captain Perry, is nearly what I should recommend. The mouth, by his plan, exposes the inner harbour too much to the seas, and therefore I would advise it to be constructed as I have laid it down. This situation admits of a harbour being made sufficiently large to contain about 260 sail of ships, and might be made to have from 12 to 14 feet of water at the entrance, at the low water of a spring tide. This perhaps is larger than what may be considered necessary, but if the depth of 12 or 14 feet at low water is given to it, and which I think is little enough, the situation is such that no great additional expense is incurred by making it so large.

At the head of this harbour, I propose a basin of about five acres, which will conveniently hold about 40 sail of ships, having a sea and communication lock, and from thence a ship-canal, of about 80 feet wide at bottom, 160 feet at water's surface, and 20 feet deep, to be made to the east wall of the North Lots at Dublin, and there to establish a wet dock or docks of such extent as the trade of Dublin may require. This dock or docks I propose to be supplied with water from the Royal Canal, from which I presume (for I have not had an opportunity of examining) a sufficiency may be had to supply it, its surface being supposed to be 6 feet above the top of an ordinary spring tide, and of course its bottom level with the low water of said tides.

Whether this canal should be continued along the present channel which lies between the North Bull and the shore, to a place called Higginbothams, about two miles east of the sheds of Clontarf, or whether it should take the windings of the main land, I am not at present able to say, not having had an opportunity of examining this sufficiently. But by one or the other of these lines it may be made, and the sum I have allowed in my estimate for that purpose, I doubt not will be found sufficient.

From Higginbothams I propose it to run along the shore to near the east end of the sheds of Clontarf, and from thence across the strand, with a regular sweep, to the east end of the North Lots, joining them about 330 yards from the river Liffey. Within these Lots there is ample room for wet docks; and they would be very conveniently situated for the trade of the northern district of the city, as well as for the convenience of the Custom-house, with the dock, at which place a convenient communication may be formed, by which ships may enter the Liffey, or they may communicate with it where the Royal Canal now

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terminates. This part of the subject, however, involves the general plan of docks on the north side of the Liffey, and requires a knowledge of local circumstances, which at present I am not sufficiently possessed of. But should this scheme be adopted, it will be easy to make plans of docks suitable to the situation. These proposed works are represented in the Plan, No. 2.

The expense of this harbour and canal will appear by Estimate, No. 3., to amount to 657,157*l*. To which sum must be added whatever the docks in the North Lots may cost, which I apprehend will fall little short of 150,000*l*. So that the whole expense of this plan may be fairly stated at 800,000*l*.

2. The second situation within the bay is that at Dunleary, and for which a plan has been proposed by Mr. Jessop. This plan, like the former, consists of a harbour to be constructed at Dunleary, having from 12 to 14 feet depth of water at low water, but capable of holding only one hundred sail of vessels, and the situation does not admit of being greatly enlarged without a very considerable additional expense. At the head of this harbour a basin of about five acres, capable of holding about 40 sail of ships, with a sea and communication lock, is proposed, and from thence a canal to be made to the Grand Canal docks near the city.

This harbour is in the same situation as that proposed by Mr. Jessop, and of about the same capacity. Its form, however, is considerably different, and better suited, in my opinion, to the reception of ships inward bound, for its mouth being pointed to the north-east, it is directly in the line that vessels must come into it, and as it is calculated to preserve the water smooth within, vessels may run boldly towards it without any fear of missing and being embayed and wrecked on the South Bull. I have made only one sea-lock in the basin, and this I propose to be sufficiently large to take in the largest vessels which frequent the port. The expense of a second lock would be great, and the waste of water greater than the saving that will arise in lockage, by taking small vessels through it; and as this entrance basin is proposed to be open for three or four hours in each tide, a sufficient number of vessels will enter to lock up to the canal during the other eight hours of the tide.

The canal proposed by Mr. Jessop, and the method he advises the work to be executed, are as judiciously and properly conceived as I can devise, and the difference in the expense between his estimate and mine for the canal is but inconsiderable. These proposed works are represented in the Plan, No. 3. The whole expense of the canal, basin, and harbour (but not that of enlarging the docks) upon the second plan, amounts, as per my Estimate in No. 4, to 489,734*l*.

3. The third situation is that of Sandy Cove, which lies about a mile and a quarter to the eastward of Dunleary, and where there is deeper water. Its situation in the bay is peculiarly eligible for the entrance of vessels who may either be riding in the Man-of-War Roads, when a storm comes on, or may be inward bound from the channel; it is also equally convenient for vessels proceeding to sea. This situation admits of a harbour being constructed similar to that at Dunleary, capable of containing 120 sail of vessels, with a basin at its head similar to that at Dunleary, and capable of holding 40 sail of ships. But the ground from thence to Dunleary is very high and rocky, and therefore the expense of making a canal for this short distance will, as appears by the Estimate, No. 5, amount to 100,410*l*. The ends of the piers being also in very deep water, namely, in four fathoms at low water, renders them very expensive. So that the whole expense of this plan will amount to 705,054*l*. being 49,184*l* more than that at Sutton Creek, and 215,320*l*. more than that at Dunleary. These proposed works are represented in the Plan, No. 4.

Having now stated the different situations where it appears to me harbours for the convenience of the city of Dublin can with any propriety be situated, and their comparative expense, I shall next subjoin the opinion of Captain Joseph Huddart, respecting the advantages and objections peculiar to each:—

"The most desirable object respecting harbours for the security of shipping, is to construct them where a sufficient depth of water to the entrance can be procured; otherwise piers must be extended to secure this object at a great expense: for where the shore is shallow to a considerable extent, besides the risk of bars, or accumulation of shoals, upon ships may strike, they often refuse their helm, or as seamen express it, steer wild, which is occasioned by the difference of velocity of the water at the surface and near the bottom when the sea runs high, which frequently causes them either to miss the harbour, or run against the piers; this generally happens with strong gales in-shore; but we have very few instances of this where the water is of a sufficient depth and the piers properly constructed, so as to keep the water in the harbour smooth during storms. A shelving or gently sloping ground within a harbour is of essential use for ships to bring up when they enter it in storms, and proper capsterns should be placed on the piers to heave them into their berth, after they have got into the harbour. A good light on the pier head is also essential. If a harbour possesses these requisites, a ship will almost always enter in safety except by the imprudence of the pilots having improper canvas set, or a bad helmsman. A light upon the pier-head is as good a direction for a ship by night as by day, the construction of the harbour being known.

"I am of opinion each of the three situations of Sutton Creek, Dunleary, and Sandy Cove, admit of the requisites I have mentioned, and ships may safely sail into any of them with a fair or in-shore wind (even in hard gales) with proper conduct.

"With contrary or off-shore winds, and moderate weather, there cannot be any danger or risks in working up to the piers, and warping in by a hawser, but in strong gales may be under the necessity of letting go a bower and furling her sails, when the wind is right out of the harbour, before she warp in, which may be safely done as the water will be smooth near the entrance. Hence, in respect to security of ships homeward bound, neither plan will have much the advantage of the others. During a hard gale from the west, when a ship is in the south side of the bay, and cannot work to windward, she might gain Sutton, when she could not Sandy Cove or Dunleary; but the contrary might happen with the wind at north, and ships coming in from the northward; and respecting Sir Thomas Page's remark, that Dunleary is too near the South Bull, in case of missing the harbour, it cannot have much weight; for if in a gale of wind in-shore a ship should miss the harbour in any of these situations, she must inevitably go on shore, and might fare worse upon the rocks at Sandy Cove than on the Bull; and if the wind is such that she can avoid going on shore in one case, in all probability she might in the other.

"In giving my opinion of the safety of the homeward-bound ships in entering the harbours, I have spoken in general terms, as no material advantage can be attributed to one above the others; but the case is different with the ships outward bound; for contrary winds, or those blowing into the harbours, rise the sea, when those off shore or out of the harbours have not this effect, leaving the water smooth, and ships cannot be long detained from entering a harbour in any of the above situations where they have sufficient water and security after they arrive in the bay; for gales seldom blow so hard for many hours together but a ship tolerably sound can work to windward in smooth water.

"A harbour at Sutton Creek is the most favourable situation for the sailing of ships bound to the southward, as they may always sail with the winds that will serve them down the channel, the course from Sutton towards Dalkey being nearly the same as from Dalkey to Wicklow Head; but ships bound to the northward, which are the greater proportion frequenting the port of Dublin, will be prevented from sailing with fresh gales from the south-west quarter, which throws in a heavy sea upon the shore on the north side of the bay; and many of the merchant vessels, especially those in ballast, will not work to windward even when they might carry whole topsails, while the sea continues to set it upon the shore; and those winds which prevail two-thirds of the time bring the heavy ocean sea up the channel; and even when the wind lulls for a time, the sea continues to fall on this side of the bay, and vessels may be detained at some seasons for a considerable time when the winds are fair to proceed on their voyage. Ships bound across the channel to Liverpool or the Head, would experience the same inconvenience.

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"The harbours of Dunleary and Sandy Cove would not be liable to those inconveniences in the south-west or prevailing winds, and the northern trade may sail at all times when the wind will serve them on their passage, except in hard gales from the south-eastward, which would confine them in all the situations; but ships bound to the southward would be prevented from sailing in strong gales from the E.N.E. which are fair for them down channel; but it ought to be considered, that though they continue for some time, gales from this quarter seldom blow hard for a long duration, nor does the sea keep up that agitation after the gale that it does when the S. W. winds prevail. The only advantage in favour of Sutton is for the benefit of the southern trade during the shorter duration of strong gales from E. N. E. to E. S. E., which in my opinion is not equal to the disadvantage from winds prevailing in the S. W. quarter, and therefore conclude that the south side of the bay is better adapted for the entrance harbour to the port of Dublin than the north side.

"The only question now is, whether Sandy Cove or Dunleary ought to have the preference? The situation of Sandy Cove has the advantage of the best water in the approach to a harbour, but this seems to be the only advantage. The extra expense of 215,320*l*., and greater distance from the seat of business, are weighty reasons in favour of Dunleary, where a harbour may be constructed equally commodious for the homeward and outward bound in the general run of trade: but circumstances may often happen that vessels meeting with contrary winds may have occasion to put back, and lay in greater readiness for a change of wind in the bay: or for various other causes come to anchor, when should a heavy gale in-shore come on and part their cables; or it might be prudent to ship at a proper time of tide, and secure a harbour before such accident happened. In all such cases the shipping would be more likely to be preserved by the harbour at Dunleary than at Sandy Cove, being farther to leeward or up the bay; and therefore all circumstances considered, I give the preference to Dunleary, and I am decidedly of opinion, that great as the expense is, it will be better to submit to this expense rather than expend a large sum on the old harbour, without obtaining the advantages in point of depth which are here to be found.

"JOSEPH HUDDART."

After what has been said by Captain Huddart, it is unnecessary for me to enter further into nautical discussions; and indeed, being conscious of his superior knowledge in these matters, what I have to say would add but little to his arguments. It is sufficient to observe, that I agree with him in giving the decided preference to Dunleary.

I am, &c.,
JOHN RENNIE.

To the Directors-General of Inland Navigation of Ireland.

ESTIMATE of the Expense of the additional Works proposed to be constructed for the Improvement of the present Tide Harbour at Dublin.

NUMBER I.

	£.
A pier to be extended from the mainland at Walshes, about half a mile east from the Sheds of Clontarf, near to the Spit buoy	110,464
Embanking the South Bull, so as to convert it into a reservoir for scouring the entrance to the harbour 400 yards wide, through the south wall near Ringsend, and arching ditto to let out the water	65,000
Jetties to be constructed in the harbour for the purpose of directing the flowing and ebbing water, &c., into the ship channel	24,000
Ballasting the bar and channel, and scouring the sand at spring tides, when the scouring will have the greatest effect	20,000
Contingencies	32,920
Total of No. I.	£252,384

NUMBER II.

	£.	
Extending the south pier 770 yards, and building a new lighthouse at the extremity of ditto	155,660	
Extending the proposed north pier from the Spit to the bar, being a length of 1100 yards	180,580	
Contingencies	67,249	
		403,488
Total of Nos. I. and II.		£655,872

Estimate of the expense of making a canal from the North Lots, east of the Royal Canal, to Sutton Creek, 80 feet wide at bottom, 160 feet at water's suface, and 20 feet deep, with a basin and harbour at its termination—657,157*l*.

Estimate of the expense of making a similar canal from the Grand Canal Docks to Dunleary—489,734*l*.

Estimate of the expense of making a similar canal from the Grand Canal Docks to Sandy Cove Bay—705,054*l*.

No. 10.
Corneille on an improved direction for the Great Clontarf Wall.

No. 10.

Captain CORNEILLE *on an Improved Direction for the Great Clontarf Wall.*

GENTLEMEN, *October*, 1802.

In the execution of the several orders with which you have been pleased to honour me during last winter and the present summer in the bay of Dublin, I had many opportunities of making several observations and experiments upon the different currents of the tide as it flows into and ebbs out of the harbour of Dublin; and I have paid very minute attention particularly to the effect of those within the lighthouse; and the result of these experiments has led me in some degree to change the situation of the pier, which I had, in my former Report, recommended erecting from the eastward of Clontarf in a straight line to the Spit buoy, with a return up the river towards the north wall, as I have since found that it will be much more prudent to shut out the entire of the sands of the North Bull from the harbour, for the reasons hereinafter mentioned. I therefore propose that this new pier should commence from the projecting point of land a little to the eastward of the sheds of Clontarf, from thence continued in a curved line by the west edge of the north wall to the Spit buoy (its direction is marked by a strong red line upon the small plan of Dublin Bay which accompanies this Report), by which means the whole body of water required to fill the harbour must flow through the space between the extremity of this proposed wall and the present lighthouse, a distance of something more than 500 yards.

At present a very great proportion of the tide flows into the harbour by Sutton Creek, round the northward of the North Bull along the Clontarf shore, and its influence is even seen so high up in the harbour as the back of Clontarf Island; now this great body of water flows over an extent of near four English miles in length alone of loose running sand, as it helps to fill the harbour, and of course must and does bring in

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Corneille on an improved direction for the Great Clontarf Wall.

with it a very considerable quantity of sand, particularly so when the sea is in any way agitated by the winds blowing from any point between the east-north-east and south-south-east. The situation of the proposed new wall, when completed, will in future evidently prevent this.

Now upon the return of the tide or ebb at present, a great body of water, commencing so high up in the harbour as the back of Clontarf Island from along the Clontarf shore by the Furlong, and also from the sheds of Clontarf, escapes and runs out through the channel at the back or northward of the North Bull by Sutton Creek from the time of high water until the half ebb, after which time its passage is prevented by the height of the sand in this channel, opposite to or near Cold Harbour: and for the last half ebb it runs by the west edge of the North Bull until it falls into the main current of the ebb tide, which passes the lighthouse: but when this proposed new wall is completed, the entire great body of the ebb tide must pass out between the extremity of the new work and the present lighthouse, and by that means add such considerable strength to the current of the ebb tide, that I am confident it will act with great effect and force at the bar of Dublin: for the curved direction of this new wall will lead the water directly upon the centre of the bar, which will be in a great measure deepened by the current of the ebb tide alone. I may assert this, for since the present south wall was finished, the stream of the ebb tide, running from the lighthouse over the south end or tail of the bar, has swept away so much of the sands as to deepen that part three feet, for there is now nine feet of water at the lowest spring tide upon the tail of the bar, instead of six feet, which was the former depth there.

It will here be necessary to observe, that from the experiments which I have made of dredging upon the bar of Dublin in several places, to the depth of three feet eight inches, I found that the stratum of which it is universally composed is small, fine, sharp, but heavy sand (samples of which are now in the possession of the Board), which I have no doubt may in part be removed by dredging,—a method I would strongly recommend adopting at the commencement of, and continued the entire of the ebb tide, so that when the sand was disturbed by the dredge, the strong current produced upon the bar by the direction of the above proposed wall would carry away all the sand which was either loosened by or escaped from the dredge into the deep water. Of this last effect I am certain, as a similar circumstance occurred during my operation of dredging upon the bar of Dublin last winter, at the last quarter of the ebb of a spring tide, a particular account of which I had the honour to communicate in my Report of the 7th of September, 1801.

I imagine that there can be but little danger of the sands again accumulating upon the bar from the very strong current that will always run there, both at the flood and ebb tides, when this proposed wall is finished.

From the foregoing experiments of dredging upon the bar of Dublin, I have ascertained that it is possible to reduce it three feet eight inches at least lower than its present surface. Having proved that the above depth of stratum is removable, but of what the under bed or layer is composed I cannot be certain, as the very tempestuous weather in which I was obliged to make these trials prevented the vessels remaining steady sufficiently long at any one station to sink deeper; and after I had broken the surface of the bar, the sands fell so fast from the sides in the hole which the dredge had made, that it was with the greatest exertion and difficulty that I was enabled to sink even so deep, although several tons weight of the sand was brought up; however, upon putting down a setting pole into the hole which the dredge had made, it was forced one foot six inches deeper, from which circumstance it is probable that the under stratum is also sand. Upon the accompanying plan, the principal stations are marked by red spots, at which the dredging experiments were made upon the bar of Dublin.

In carefully examining the part of the North Bull through which I had proposed carrying the wall described in my former Report, I have found by its straight direction to the Spit buoy, that a very large tract of sand, half an English mile in breadth, and near one mile and a quarter in length, would remain inside the harbour, which will be avoided by giving the wall the great curve by the edge of the North Bull, as proposed by my present plan.

It is true that a great addition of water might be obtained to pass out by the lighthouse, in allowing that space to remain within the harbour, and if a wall was erected even more to the eastward than what I had at first proposed, a much greater quantity would be procured, but this great body of water will all pass out during the first half ebb, and leave the tract of sand which would be taken into the harbour perfectly bare and dry rather before that period, so that no supply from that space will be obtained at the last quarter of the ebb tide, at which time only the assistance of an additional body of water would be of advantage in increasing the current of the tide: as after the first half ebb of a common tide there is no less than 870 yards of the sands of this part of the North Bull dry, measuring from the centre of the sand hills in a line with the watch-house at Ringsend; and besides, the straight direction of that wall would lead the water by the lighthouse in a south-east course over the tail of the bar, and not upon the centre, at which part it will be of the most advantage for the current to act with strength. I therefore think it will be more prudent to exclude the whole of the sands of the North Bull, as I apprehend that the strong current running into the harbour through the proposed opening at the flood tide, would stir up and carry in with it a very great quantity of those sands, and also fear, that upon the ebb tide much may be carried out, and perhaps might accumulate upon the bar; for this part of the North Bull, and indeed the whole of its edge, is composed of a very fine loose sand to a considerable depth (having bored a little to the west of the Spit buoy, so low as 16 feet, without even meeting with gravel), the surface of which now moves with the flood tide in the calmest day, which any person may see by taking the trouble of waiting upon the spot until the flood tide commences; besides, if any part of these sands are allowed to remain within the harbour, it will be necessary to mark out their edge with buoys to prevent vessels running upon them when obliged to tack up, which now often occurs, but will be avoided if the proposed curved wall is adopted.

It is well known that the most prevalent winds which blow in our harbour are those between the north-north-west and south-south-west points of the compass, with any of which vessels are obliged to tack to make the river, and as at present few, if any, attempt to cross the bar of Dublin until past the half flood, the strength of which is so much spent by the time the vessels reach the Pigeon-house, that they are obliged to come to an anchor at that station, and wait there for the following tide to get up into the river; and it also very generally happens, by the wind changing and blowing hard right down the river, that entire fleets of merchantmen and colliers have been detained at the above station for a number of days; whereas, when this curved wall is completed, the strength of the flood tide will be so much increased by the contracted entrance through which it must then flow, that its very strong current will enable all ships to enter our river in the one tide, notwithstanding a contrary wind; likewise vessels outward bound will have it in their power to get out to sea in the one tide, although the wind might happen to be against them.

To the many advantages already stated, which must arise from the direction of my proposed wall, may be added, that of its affording shelter to the shipping in the harbour from those winds which blow from between the east and north points, particularly from that of the north-east, which wind creates so very rough and heavy a sea within our harbour as frequently to roll over the present south pier.

Having now stated, with as much brevity as the nature of this important subject would admit, the very great improvement and many advantages to the harbour of Dublin that would arise by erecting a wall in the proposed curved direction, I have only to add, that its extent from A. to B. (see plan) will be 7,260 feet, the estimate for which will be 24*l.* per foot, making the total amount for the above distance the sum of 174,240*l.* sterling.

I have, &c.,

DANIEL CORNEILLE.

To the Right Hon. the Directors-General of Inland Navigation.

APPENDIX B.

DUBLIN.

No. 11.

Reports by Messrs. Giles and Halpin, Mr. Telford, and Mr. Whidbey, on the proposed Clontarf Wall in the Bay.

No. 11.

Reports by Messrs. GILES and HALPIN, Mr. TELFORD, and Mr. WHIDBEY, *on the proposed Clontarf Wall in Dublin Bay.*

SIR, *Dublin, 6th May*, 1819.

We have, in obedience to the directions of the Board, viewed the North Bull, both at high and low water, and we have jointly settled our opinions upon the most eligible situation and direction of the proposed wall or embankment from the shore of Clontarf towards the Spit Buoy.

The leading objects to be attained by this wall or embankment are—

1st. The sheltering of the harbour.

2ndly. The prevention of the sands passing from the North Bull into the harbour; and—

3rdly. To admit as great a body of tide-water as possible into the harbour, and to return the same past the lighthouse, within such limits and in such direction as will produce the best scouring power to deepen the bar, with the least obstruction to the navigation into the harbour.

To effect these objects, we are of opinion, "That, in the probable event of the South Wall being hereafter extended from the lighthouse towards the bar, and the embankment on the north side being also carried to the bar," the present works should commence by embankment from near the west end of the Sand Island, and pursue a straight line between a point "500 feet west of the eastern side of the road leading from Cold Harbour to the Green Lanes" and the Spit Buoy, which will be S.E. ¼ E. true bearing.

This straight line we propose to extend to the distance of 2000 yards south-east from the shore of Clontarf, and there to commence a parabolic curve towards a point due north of the lighthouse, by which curve the direction of the ebb-current will be graduated to a suitable course for effecting the best scour at the entrance of the harbour and upon the bar, and the proper width of the entrance will be practically determined as embankment proceeds by its operation upon the current in the channel. The direction of the above line will, likewise, be well adapted to obviate the ravages of the south-easterly winds upon the embankment.

We are likewise of opinion that a causeway, for an access to the works, should be made across the North Gut or Channel, between the Sand Island and Clontarf shore, in the same direction as the straight line of the embankment. This causeway should be formed at each side of the gut by embanking, and supported in the middle (for the space of 200 yards) upon open piling, through which the tides will still have passage, and the channel be thereby kept open.

We have, &c.,

John Cossart, Esq.

FRANCIS GILES,
GEORGE HALPIN.

SIR, *16th August*, 1822.

In consequence of your requisition I lost no time in making a journey to Dublin, and have to acknowledge the receipt of yours of 8th, containing instructions from the Corporation to inspect the port of Dublin, and report upon the state of the works now carrying on for its improvement, the effects they have already produced, and what, in my opinion, is likely to be the result of any other operations which I may think proper to recommend.

I was glad to find the Great North Wall in so forward a state, having already been carried for a distance of about 5500 feet to its full height, and about 1500 feet further to the level of high-water neap-tides; also about 500 feet more to the level of half-flood, all of which seems to have been performed substantially and with economy. The effects of this wall, in its present state of progress, are already very evident; for the Sand Banks in the interior, having been deprived of their usual supply from the Great North Bank, have already been lowered more than 3 feet on an average, while the part of the bar which is immediately opposite the present harbour mouth has likewise been lowered from 6 feet 6 inches to 8 and even 9 feet; whilst the western part of the bar, which is adjacent to the Old Channel, is remaining 7 and 7 feet 6 inches only, so that already a direct entrance is formed of sufficient depth for most of the vessels which frequent the port of Dublin.

But, notwithstanding the great extent to which the North Wall has been successfully carried, I consider the entrance still considerably too wide to produce the full effect of deepening the bar, or forming a perfect and direct channel within the Great South Wall—objects so essential to the perfecting the general entrance of the port. I, therefore, strongly recommended that Mr. Halpin may, as he has very judiciously proposed, be authorized to add a still further extension of about 500 feet to the Great North Wall, to be carried forward with great caution, observing the effects produced upon the current of the flowing and ebbing tides during the ensuing winter; and this extension should not, for the present, be raised above the level of half-tides, until the above-mentioned effects have been fully and carefully ascertained, after which the most advisable measures for completing this great work, both as to shape, extent, and height, may with propriety be determined.

With regard to the changes which have already taken place, both within and without the pier-heads, they are precisely what might be expected, and in truth desired. Any quantity of sand which can be carried from the comparatively small space within the piers, the harbour mouth, and spread at large over the Great Bay, can produce no visible or injurious effect. It would, in my opinion, be desirable, that sand from any quarter would accumulate on the south side of the extremity of the head of the South or Lighthouse Wall, because this would tend to guide the ebb-tide in a more direct channel from the entrance, instead of the present very inconvenient and crooked one.

With the precautions which Mr. Halpin is now taking, of shoeing the mound upon which the lighthouse stands with rubble-stones finding their proper slope, no danger need be apprehended to that useful edifice.

THOMAS TELFORD.

John Cossart, Esq., Ballast Office.

SIR, *Dublin, 20th September*, 1822.

Agreeable to the request you have made in your several communications to me, by the directions of your Board, I beg you will please to inform them that, since my arrival at Dublin, I have taken a general view of the harbour as well as the new embankment; but, before I give my opinion on the subject, I beg to offer a few remarks upon the Bar Harbour in general. Bars of harbours are more or less deep according to the quantity of back-water that is discharged out of them. The formation of bars is caused by river and tide-water; they, in their course to the sea, being loaded with alluvial matter by soil being washed from the country and dirt from the towns as they proceed to the sea.

Those waters then receive a sudden check by striking a large body of sea-water at a right angle, which probably may be motionless, and prevents, in a great degree, the river and harbour waters continuing their course, and, consequently, the alluvial contents of them must fall to the bottom and forms the bar, which is the cause of the formation of the bar at Dublin, and on that principle every bar in the world is so formed.

I have said before, that bars of harbours are less or more deep according to the quantity of back-water they contain to keep them down. The sluggishness of the river Liffey, and the shallowness of the harbour,

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Reports by Messrs. Giles and Halpin, Mr. Telford, and Mr. Whidbey, on the proposed Clontarf Wall in the Bay.

from the lighthouse up to the city, both combined, does not produce back-water enough to scour away the bar, and therefore an increase of it is wanted.

This appears to have been foreseen by your Board, by causing the present embankment to be made on the sand banks from Clontarf shore towards the lighthouse; and, I must confess, a bolder measure, or one of more value to the port of Dublin, could not have been produced, and a measure calculated to give the port all it wanted, that of deepening the bar: and it is my firm opinion, a more judicious plan could not have been suggested, or better carried into effect, by the able and persevering talents of Mr. George Halpin.

This embankment, I have great reason to expect, will, by drawing in the flood-tide, be the cause of scouring out from within it large bodies of mud and sand, which will be replaced by water, and will assist in scouring down the bar. And I think it very likely, that the Spit sand will, in time, be so much washed away as that vessels will be enabled to anchor and take shelter under the head of the embankment; and whilst this is going on, the embankment will stop the progress of the sand from moving from the North Bull up the harbour, and will, at no great distance of time, become good grazing land.

These are the good effects, I make no doubt, will be produced by the embankment

I beg to recommend, that the passage under the bridge of embankment should be kept open, as there is a channel that runs some distance alongshore to the northward that contains much water, and as this water on the ebb-tide runs to the westward, and joins the harbour tide, makes some addition to the back-water.

Having given you fully my ideas on the effects of back-water, and what I expect will be produced in consequence of the erection of the embankment, I have now only to say what I think ought to be done.

The information I have received states, that the Spit sand and other sands within the embankment are reducing; that a new channel on the bar has been found, and with deeper water in it than what the old channel contained; and it appears that this alteration has been produced since the embankment has been brought so near the lighthouse. This being the case, and exactly what it was expected the embankment would produce, I beg to say, I am fully of opinion, under these circumstances, that no further extension of the embankment should be made, but wait and see what the effect the present extension of it will produce before anything else is done, excepting levelling the outward end by filling up the uneven surface at the top and sides.

John Cossart, Esq. JOHN WHIDBEY.

No. 12.

No. 12.
Memorials on the necessity of a Ship Canal from Kingstown to Dublin.

To His Excellency the most Noble the MARQUIS OF ANGLESEY, &c. &c. &c. The Memorial of RICHARD BOURNE, a Principal Proprietor of the "Shannon," "Thames," "City of Londonderry," "Royal Tar," and "William Fawcett" Steamers, plying between Dublin and London,

HUMBLY SHOWETH, 24*th December*, 1832.

That your Memorialist sustains great loss and injury from the general deficiency of water, and the numerous shoals, &c., which impede the navigation of the river Liffey, and on which the vessels of your Memorialist have frequently grounded, although under charge of the pilots appointed by the Ballast Board. That these vessels are liable to strain and damage from being obliged to lie aground, under heavy cargoes, alongside the quay wall, during the period of low water, although of a light draught, and are often, particularly at neap tides, obliged to proceed to sea with less loading than their capacity would admit of, in consequence of the shoaliness of the river.

That the Harbour of Dublin, at present one of the worst in the country, is capable of being made amongst the best in the empire, by the construction of a floating dock and a ship canal, connecting it with the Royal Harbour at Kingstown.

That the surveys of the late Mr. Killaly, and the inquiries of Mr. Griffith, and other eminent engineers, have established the practicability of such work. Some difficulties which had presented themselves to Mr. Killaly, in carrying off a portion of the water of the Liffey, and the drainage of the city, have been obviated, and your Memorialist doubts not being able to remove any other objection that may be suggested on the occasion.

The Corporation for improving the Port of Dublin have executed works that do honour both to themselves and to the country; their labours, however, aided as they have been for more than half a century by great science, and a profuse expenditure of money, have failed to remove the numerous impediments and dangers which encumber the navigation of the river, and forcibly illustrate the impossibility of rendering it a safe or a commodious harbour, or of adapting it to the increasing commerce of the city.

That the revenue of this Corporation amounts to 70,000*l.* or 80,000*l.* per annum, leaving a considerable annual surplus, for which your Memorialist understands there is not, at present, any immediate or necessary application, he most respectfully suggests, that a sum of money sufficient for constructing a ship canal from the Harbour of Kingstown to a floating dock, embracing a portion of the river, and its marine quays, shall be borrowed on the security of such surplus revenue, and that the interest of such loan shall be paid thereout.

That your Memorialist has been informed, that the expenses of making a ship canal, and the necessary works connected with it, have been estimated at 500,000*l.*, the interest of which, at 3½ per cent., would amount to 17,500*l.* per annum.

That the extensive docks and stores of the Custom-House, at present nearly valueless, would thereby be rendered objects of considerable revenue and commercial accommodation; while the docks of the Grand and Royal Canals, which now, perhaps, present melancholy instances in which inconsiderate enterprise has failed to realize any beneficial result, may yet be rendered available to the interests of their long expectant proprietary.

Your Memorialist therefore humbly prays, &c.,
RICHARD BOURNE.

To the Right Honourable the LORDS COMMISSIONERS OF HIS MAJESTY'S TREASURY, the Memorial of the undersigned Directors of the Dublin and London Steam Marine Company, and of the Auxiliary Steam Marine Company, on behalf of themselves and others;

HUMBLY SHOWETH,

That on the 11th February, 1833, the subscribers memorialed your Lordships respecting the very dangerous and defective state of the river Liffey for the purposes of navigation, and praying that a portion of the revenue of the Ballast Corporation, now expended in what your Memorialists considered inefficient efforts for the improvement of the river, should be applied to the construction of a ship canal, to connect the harbour of Kingstown with a floating dock, comprehending the mercantile quays of the city.

That this memorial was referred to the Ballast Corporation: some of the servants of that establishment, probably considering that the confidence of assertion might be received as evidence of its correctness, and that, as on a recent occasion, inquiries might be again averted by a general and bold denial of the existence of any fair occasion for it, they, in two long reports to your Lordships, dated 15th January and 7th March, 1833, denied in positive terms every allegation in the memorial.

That your Memorialists, humbly conceiving that not only their individual interests, but that of the trading community of Dublin, are engaged in the subject of the present investigation, involving the question whether Dublin shall be rendered amongst the finest sea-ports in the empire, or remain, as it now is, a most

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inconvenient and highly dangerous tide harbour, respectfully presume to offer to your Lordships' consideration the following observations and facts in reference to the two reports of the Ballast Corporation.

That the ostensible writer of the reports, Mr. George Halpin, probably too credulous in the statement of others, appears to have embarked his confiding principles in the errors into which he had himself fallen; he declares that the statement of dangerous holes having been created by excavating the Greenpatch and other shoals in the river, "was certainly a mistaken assertion," and that he cannot discover any ground for the statement, "that several ships have been either overset or sunk in these excavations." If occasion be afforded the Memorialists, they will establish both these allegations by satisfactory evidence; and they will further prove, in addition to the instance before quoted, illustrative of the facts, that on the 10th April last the brig "Jamaica Packet," of Whitehaven, laden with coals, grounded opposite the Patch, and on the falling of the tide, her bow sank into one of these denied holes in twelve feet and a half water, whilst her stern rested on the bank in two feet water.

A person so respectable as Mr. Halpin is reported to be, should perhaps have been better informed before he gave official authority to an erroneous statement, which was calculated, if not designed, to frustrate the exertions of many of the friends of Ireland, of making its capital a seat for commerce, and giving to it one of the finest artificial harbours in the world.

Mr. Halpin, in his report of the 15th January, says, "along the quays the banks have been greatly lowered and levelled, and all stones and inequalities removed." A few recent facts will show with what success this important operation has been attended. On the 29th of last March, the schooner "Thomas," of Dundee, 78 tons, Anderson master, laden with wheat, sunk in the river, in consequence of grounding on a bad uneven bottom. About the same time the brig "Avon," of Newcastle, laden with coals, while lying opposite Mr. Curry's timber store, broke her back and seven of her futtocks, and was otherwise considerably damaged, by grounding on a foul and uneven surface. The schooner "John," of Liverpool, of 80 tons, Hodson master, laden with coke, sunk a short distance from the entrance of the new dock, in consequence of resting at the ebb-tide on the remnant of the piles which had formerly formed the coffer-dam, and which had been suffered to remain, notwithstanding that the "Maria," of Memel, now a wreck in the Ringsend Dock, had been lost some years since by the same cause. That about three years since the brig "Joe," of Dublin, of 120 tons, coal laden, lay in tier nearly opposite Luke-street, on the south side of the river, and broke her hog (placed over her keelson), and also one of her lower deck-beams, in consequence of lying upon what is supposed to be an old foundation of a wall, which runs a considerable distance parallel with the quay wall. The "Economy," corn laden, had her back broken at the same berth, and several other vessels have also sustained more or less injury, and the liability still continues, as the old foundation remains undisturbed. If these facts do not sufficiently illustrate the inaccuracy of Mr. Halpin's assertion, of the bottom of the river having been "levelled, and all stones and inequalities removed," others can be adduced.

That Mr. Halpin next states, that from the works now carrying on there will this spring be seven feet water in the channel, from the Pigeon-house to the North Wall, at low water of spring-tides, and adds, "even now the greater portion of the vessels trading to Dublin can, at high water of the poorest neap-tides, pass up the river, the improved state of which is evinced by the larger class of vessels which enter it, and the discontinuance of the merchant lighters, which were formerly indispensable." In reference to this statement, your Memorialists beg leave to instance the case of the "Killarney," steamer, which grounded near the Green-patch, on the 15th of last April, and again on the 13th instant, and was obliged, on both occasions, to discharge a portion of her cargo into lighters, in order to get up to the quays. In the month of September, 1832, the "Margaret," 272 tons, M'Munn master, having a fair wind with a spring-tide, was obliged to discharge in the like manner, at an expense to the owners of upwards of 76*l*. The steam-vessels belonging to your Memorialists have frequently been obliged to lighten, by means of barges, to enable them to pass up to the quay; and when outward-bound, to put into lighters a portion of their cargoes, which they would take on board after they had passed the shoal-water. The assertion that the depth of water in the river is so much improved that the generality of vessels trading to the port can reach it at high water of the poorest neap-tides is not perhaps sustained by the fact, that it often happens that there is not 10 feet water at the quay; and that on the 15th of April, the "Sarah," of Whitehaven, drawing 12 feet, had been three days neaped in the centre of the channel, abreast of the King's Bond-yard; and that the barque "Lotus," of and bound to St. Andrew's, was, from the same cause, detained three days opposite Mr. Wilson's stores. The instances of the insufficiency of water in the Liffey, for the purposes of the ordinary coasting trade, would occupy more of your Lordships' time than your Memorialists would venture to trespass on.

Mr. Halpin proceeds to state, "With respect to the small bank referred to in the affidavit annexed to the Memorial, it was laid down on the lithograph published by the Board, giving a comparative view of the bar and channel in the years 1800, 1818, and 1831: a few of the unfinished proof impressions, not intended for circulation, did not show this shoal. The smallness of the scale on which the plan was printed doubtless caused Captain Head to overlook its actual insertion, or its true position and extent. It has been well known to the pilots; and occasionally marked by buoys, but as they were constantly carried away, and from the extreme narrowness and softness of the bank, no injury having ever been sustained, it was deemed unnecessary to continue the buoys. The shoal is a small ridge, very narrow on the top, falling rapidly on both sides, and the depth on it has continued nearly the same for the last three years." To those acquainted with lithographic printing, it possibly may appear singular that any particular portion of a section laid down on the stone, should not come off with the rest of the impression, and that where a shoal was intended to be exhibited with five or six feet water on it, and that on its identical site a channel of 16 to 23 feet water should be represented in its stead. It may also appear extraordinary that the "few unfinished proof impressions, not intended for publication," were those, and it is believed those only, which were published by the Ballast Corporation. It certainly appears that two of these "unfinished proof impressions" were, on application, sent to the Secretary of the Commissioners of Kingstown Harbour, and that another was sent to the Chamber of Commerce, and is suspended in the public room of that institution. Two others which, like the foregoing, bear autographic tidal notes and soundings, with every indication of careful and studied finish, are likewise in the possession of your Memorialists; but their most active inquiry and research have failed, not merely to obtain a chart on which the shoal in question has been exhibited, but to ascertain that such a chart ever existed; the respectable tradesmen who executed the comparative chart without the shoal never made but one set of impressions, and never heard of a second. Mr. Halpin says, the buoy which had been cautionary of this shoal, "was constantly carried away." It is proved by Captain Head, that a buoy was placed on the bank some years since; and that within a few months afterwards it was removed, and it is notorious that the shoal has for some years been without any notation whatever.

Mr. Halpin will probably be afforded an opportunity to prove how and when the buoy was removed; whether on such removal, by accident or otherwise, it was ever replaced, and if so, how often, as his observations, that "they were constantly carried away," necessarily implied as constant replacement, during the short period that such beaconage was considered necessary.

Mr. Halpin considers this bank to be so soft as to be innoxious, and yet it consists of hard, acute, and ponderous gravel, quite different from the white sand of which the neighbouring banks are composed: and he observes, that the buoy was discontinued, "no injury having ever been sustained from it." It might have occurred to him, without much tenacity of memory, that in the spring of 1832, the "Eleanor Potts," of Whitehaven, going to America, grounded on this bank, and after hanging on it for some hours, was extricated the following tide. The master was then uninformed of the shoal, and on his return to Dublin early in the last month, although apprized of the existence of this bank from his previous experience of it, yet probably forgetful of its precise position, or conceiving from the circumstance of its being unbuoyed that it had been dislocated, he again grounded on it, and for some time remained in considerable peril. On the 22nd August, 1831, the "Castlereagh," of South Shields, Coats master, of 214 tons, struck on this shoal

No. 12.
Memorials on the necessity of a Ship Canal from Kingstown to Dublin.

at high water, and on the falling of the tide her stern rested on the bank in six feet and a half water, whilst her bow was plunged into 15 feet water; her deck, cargo and anchors, &c. were removed, and with the assistance of a lighter at her bow, she was, with much difficulty, got off the succeeding tide. It was not at that time apprehended that she had sustained any material damage, and she proceeded on her voyage to America: but on her return homewards she foundered at sea, and all on board perished. It was forcibly expressed by Mr. Harker, late superintendent of mail-coaches, before a Parliamentary Committee for reducing Highgate-hill, that a horse did not always die at the moment his heart was broken, implying that life sometimes lingered beyond the cause of its extinction: it is possible that the wreck of the "Castlereagh," as well as the recent calamitous loss of the "Erin" (which having shortly previous to her awful disappearance grounded on the uneven bottom at the Green-patch, where she lay neaped for six or seven days), may perhaps be received in melancholy confirmation of Mr. Harker's theorem. This bank is now in process of being dispersed (not dredged away) by one of the steam-machines of the Ballast Board, and it is not unreasonable to suppose that it will form again in some other place not far distant, where its exact position may not be so well known to masters of vessels as it was formerly.

Your Memorialists, impressed that not only their individual interests, but those of the trading community of Dublin and its vicinity, are deeply involved in the subject of this Memorial, implore your Lordships to cause inquiry to be instituted into the affairs of the Ballast Corporation of Dublin, through the medium of a Select Parliamentary Committee (which they humbly conceive is alone competent to examine into the revenues of that Board, and their appropriation of them), with a view that a portion of those revenues shall be applied to the more certain and easy improvement of the port of Dublin, by rendering the River Liffey, between the mercantile quay walls, a floating dock, and by the construction of a ship canal from thence into the deep waters at Kingstown harbour.

(Signed)	RICHARD BOURNE.	JOHN MALLETT.
	JAMES HARTLY.	F. BOURNE.
	WM. L. GUINNESS.	GEORGE DARLING.
	THOMAS MAXWELL.	W. H. BOURNE
	WM. HENRY FORTESCUE.	

17, *Eden Quay, Dublin, 28th May*, 1833.

JOHN MORGAN,
Accountant to the Dublin and London Steam Marine Company and to the Auxiliary Company.

No. 13.

No. 13.
Reports by Halpin, and others, on the project of a Ship Canal.

Reports by MR. HALPIN, and others, *on the project of a Ship Canal from Dublin to Kingstown Harbour.*

SIR, *North Wall, 15th January*, 1833.

Conformably to the directions I have received (having read and considered a published memorial from Richard Bourne, Esq., to the Lord Lieutenant, requesting the exertion of his Excellency's influence to inquire into and forward the project of a ship canal from Dublin to Kingstown Harbour), I have the honour of laying before you the following brief statement of facts, the consideration of which should not be omitted in forming any plan having in view the professed object of the proposed ship canal.

I am the more induced to this, from a knowledge that various misrepresentations have been made from time to time concerning the harbour of Dublin; some of them intimating that it has not improved, nay, that it has deteriorated, and that the various works effected have been fruitless. Previous to pointing out the inaccuracy of such statements, it may be well briefly to review the progressive changes which have taken place in this port within the last 30 years.

Before the year 1800, and for some time afterwards, the bar of Dublin formed a serious obstacle to entering the river, the course past it was circuitous, shallow, and liable to alteration. The river, which Captain Bligh describes as "filled up with sand at the low water, except a small channel near the wall, irregular in its depth, and where very few ships can find a place to lie afloat at low water," was obstructed by banks and shoals; of these the Ford, having on it but 6 feet at the low water of spring-tides, crossed the channel between the Pigeon-house and Poolbeg. Westward of this the river shoaled up to the Green Patch, a bank between the Pigeon-house and Ringsend, which was of considerable extent in the direct passage, and had on it but from 18 inches to 3 feet at the low water of spring-tides, forming the greatest hindrance to vessels passing up the quays, those of sharp build having constantly to wait below it for the spring-tides, or unload part of their cargoes into lighters. The wall from the Pigeon-house to the lighthouse was, where most exposed, low, and wanted backing. The quay walls were of rubble masonry in a ruinous state, and requiring a constant heavy expenditure for repairs. The banks of the river at the quays were uneven, covered with quantities of stone and shingle, and ill adapted for the grounding of vessels.

To facilitate the transactions of commerce and improve the city, the old quays were taken down and the present built. To those who have seen the former, it is unnecessary to state how great was this improvement.

The Corporation, for improving the port, after collecting all the necessary information, and obtaining the advice of the most eminent scientific and practical men of that day, determined on the erection of the Great North Wall: this work was commenced in 1820. It has a S.S.E. direction from the Clontarf shore towards the Poolbeg Lighthouse, forming a pier of better than a mile and a half in length. By this it was purposed to confine the tide of ebb and direct it on the bar. As its primary effects an increasing depth over the bar was found to take place in the line of the present channel, and where, when the wall was commenced, there was a depth of only from 5 to 7 feet, it subsequently increased to 7 and 9 feet. There was also a diminution of the breadth of the bar. This progressive deepening has continued up to the present day, insomuch that there is now a channel across the site of the bar, which, in its shoalest part, has from 11 to 12 feet depth at the low water of spring-tides, and average depth of 14 feet throughout its length, having directness, depth, and breadth, which were all wanting in the former southern channel. An inspection of the charts made at the periods alluded to will more fully show this important change.

This course of improvement was not, in the meantime, confined to the bar; the depth has been considerably increased throughout the whole river channel, from Poolbeg to the city quays. In Poolbeg anchorage, which is now much better sheltered by the raising and proper backing of the Lighthouse Wall and construction of the Great North Wall, there is an average depth of 14 feet at the low water of spring-tides. The Ford Bank has been dredged away; the channel deepened and straightened up to the Pigeon-house, and thence to the Green Patch Bank, which has nearly been cut through by one dredging machine, and the lighters now working on it. The additional steam-dredge which has been built, and will shortly be ready, will expedite this improvement. By excavating with these dredges there will be a passage through the whole length of the Patch Bank this spring, and a channel made from the Pigeon-house to the North Wall, having 7 feet as its least depth at the low water of spring-tides, and 150 feet as its width. Even now, the greater portion of the vessels trading to Dublin can, at high water of the poorest neap-tides, pass up the river, the improved state of which is evinced by the larger class of vessels which enter it, by the infrequency of accidents, and the discontinuance of the use of merchant lighters, which were formerly indispensable. With the present machinery, a channel, 8 feet deep at the low water of spring-tides, would be carried up to Carlisle Bridge in

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a few years. The steam-packets are, however, at present in some measure water-borne at their berths near the quays (at low water). Of the little injury sustained in this way, the public have had a strong instance in the "Thames,' London steam-trader, lately coppered on the Ballast Office graving slip, the keel, bottom, and old copper of which were unbroken, in good preservation for the time they had been used, and had received no injury from a six years' trade between this port and London that would not have been incurred in a deep-water harbour.

Along the quays the banks have been greatly lowered and levelled, and all stones and inequalities removed.

The graving slip was finished last year: it is capable of taking up steam-vessels of the largest class, which cannot be repaired elsewhere in Dublin. Since its completion, it has been generally occupied by vessels of from 300 to 500 tons' burthen, and is likely to prove most useful to the port.

But it is now asserted by some, that this progress of improvement avails nothing, and cannot eventually produce adequate convenience for the wants and interests of the commerce of this city; and that, abandoning all that has been done, a more expeditious plan should be followed—that a ship canal should be formed from Dublin to Kingstown. I say, abandoning all that has been done, for there is little doubt that Captain Bligh predicated truly in writing—"I impress it strongly as a principle, that a canal and the Liffey would destroy each other, as both would be too expensive to keep up, and the general bias would at last go in favour of the latter." This talented officer was appointed by Government to survey Dublin Bay, and suggest plans for the improvement of the harbour, of which he necessarily acquired a thorough knowledge. Whether his assertion, as to the probable determination of public opinion, be correct or not, the abandonment either of the river or canal would not the less take place.

As a reason for undertaking some such plan as the proposed canal, it has been urged, that no expenditure can render the Liffey navigable at low water up to the quays. Even admitting this assertion, the objection will appear frivolous, when it is considered that the harbour of almost every commercial port in Great Britain is tidal, that is, can be navigated by vessels of a large class only at or near high water. The commerce of Liverpool is carried through a dangerous channel, which cannot be passed at low water; this is also the case at London, Bristol, &c, the access to many of which is more difficult than to Dublin.

Some of the proposers of a ship canal to Kingstown Harbour have an opinion, that, on its being made, the necessity for dredging would cease: this would not follow. The mud and sands brought down by the Liffey in floods are at present partly deposited on the banks and strand, but would be confined to the canal if connected with the river: should it not be connected with the river, the Custom-house docks and warehouses, and the warehouses of the different steam companies on the north side, should be virtually relinquished, and other exceptionable consequences follow.

Several projects for a ship canal from Dublin to the deep water in the bay have, at various times, been put forward, among which was a recent one by the late Mr. Killaly. Its defects were pointed out by Mr. Nimmo, in a report submitted by him to the Chamber of Commerce, in 1831. The latter also gave a plan, the expense of which was hastily estimated at 500,000*l*. A knowledge of the localities will show any professional man the utter inadequacy of this sum to execute so extensive a project.

But when it is considered what has been effected within a few years for the harbour, with comparatively slight means,—the raising of the Lighthouse Wall; the building of the Great North Wall; the quays; the new graving slip; the forming a good channel north of the bar; deepening the river through its whole length; lowering and clearing the river banks,—it may be confidently expected that the progress of the present operations, principally of the river excavation, would, in a few years, effect a great improvement in the port, and deepen the river channel so as to give a greater depth at high water than it is proposed to maintain in the canal, and a sufficient depth at low water to keep vessels afloat or water-borne, having a much greater breadth than could be given to a canal, and which would not cause a greater expense in keeping open than does the present channel.

I abstain from any observations on the mis-statements which have been made of the revenues and expenditure of the port, leaving this duty to the department to which it more directly attaches.

I trust these remarks will be viewed in the light they are offered, not as intended to decry the merit of any project having so praiseworthy an object as the benefit of the commerce of this city, but solely in the hope they may prevent erroneous impressions being formed from interested or careless statements, and contribute to induce due inquiry and consideration before it is contemplated to abandon the experienced advantages of the present operations—consistently pursued.

I have, &c.,

John Cossart, Esq.

GEORGE HALPIN.

SIR,

Ballast Office, Dublin, 10th January, 1833.

I have, according to the directions of the Board, read the memorial of Mr. Bourne, addressed to his Excellency the Lord Lieutenant on the subject of a ship canal, in which there appears an abstract, purporting to be taken from the account of the Corporation for the year ending on the 5th of January, 1831; but, as this abstract affords a very illusory view of the income, I would beg leave to call attention to what appear to me to be errors, as well as the assumption that the duties now paid by vessels entering the river could continue to be levied without affording them the present channel.

1st. An estimated amount of profit on Graving Slip (the receipt as yet quite uncertain)	£1,000	0	0
2nd. Pilotage. (This affords no revenue, as the full amount is repaid to the pilots)	5,145	4	1
3rd. Quay Wall Tax, west of Carlisle Bridge. (Not applicable to the works in the harbour)	788	1	9
4th. Collection on North Lots. (Appropriated by law to a private Committee for local purposes)	51	18	11
5th. 4*d*. per ton, Ship Canal Tax. (This an imaginary sum)	4,158	11	3

A reference to the printed Parliamentary accounts will show the important, as well as indispensable uses, to which the real income was applied in that year.

I would also beg to point the attention of the Corporation to the account of the year which ended on the 5th of January, 1833, and which will shortly, as usual, be submitted to the Commissioners for Auditing Public Accounts: from it may be drawn an opinion of the future state of the funds, as well as the objects in which they were engaged. A copy of this account is annexed.

To these observations I have to add, the Corporation, being impressed with the important benefit that would result to the port from extraordinary exertions towards deepening the river and the earliest possible completion of the works commenced, were induced, during the last two years, to anticipate the probable revenue to the extent of 11,000*l*., and have contracted for a superior steam-dredging vessel, in addition to the one now in use, which will incur a further charge of 5000*l*., as well as a largely-increased annual expense so long as she is employed; therefore, under these circumstances, it will be evident that the annual revenue is now under engagements which must continue to press for some time to come.

I am, &c.,

John Cossart, Esq.

WILLIAM BIGGER, *Ballast Master.*

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No. 13.
Report by Halpin, and others, on the project of a Ship Canal

SIR, *North Wall, 7th March,* 1833.

Conformably to the directions of the Board of the 1st instant, I have read the memorial from the London and Dublin Steam Marine Company to the Lords of His Majesty's Treasury, complaining of the state of the River Liffey Channel, and suggesting that a ship canal to Kingstown Harbour should be substituted for the present river navigation. Thereon I have the honour to submit the following additional observations, referring to my report of the 15th January, made by order of the Board, in consequence of a memorial to his Excellency the Lord Lieutenant from Richard Bourne, Esq.

In that report I noted the former state of the river, its present condition, the works proposed, and the well-grounded hope of their effecting a further considerable increase of depth throughout the river. To this great object of increasing the depth of the channel, so as to keep pace with the important improvement in the depth of water on the bar, noticed in my former report, the Corporation have been lately enabled to extend their principal attention, in consequence of the completion of the Great North Wall, of the extensive works for the improvement of the quays, and of the new graving slip.

In the memorial it is stated that the channel now being cut between the Pigeon House and the North Wall is rather injurious than serviceable. This is certainly a mistaken assertion, and cannot be borne out by an examination either of the bed of the river, or of the state of the steam and other vessels frequenting the port. The limits of the excavation have been most carefully buoyed, and, with ordinary precaution, there is no reason to apprehend the taking place of accidents by vessels grounding on its edge: improvements of a similar nature necessarily for a time present some inconvenience. Of vessels being in any degree strained or injured there have been very few instances, nor can I discover grounds for the assertion set forth in the memorial, "that several vessels have been either overset or sunk in the excavation." Ships passing too late on the tide, or incautiously stretching their tacks too far on the banks running north and south of the buoyed channel, may be thus left aground at low water.

With respect to the small bank referred to in the affidavit annexed to the memorial, it was laid down on the lithograph, published by the Board, giving a comparative view of the bar channel in the years 1800, 1818, and 1831; a few of the unfinished proof impressions, not intended for circulation, did not show this shoal. The smallness of the scale on which the plan was printed doubtless caused Captain Head to overlook its actual insertion in its true position and extent. It has been well known to the pilots, and occasionally marked by buoys: but as they were constantly carried away, and from the extreme narrowness and softness of the bank, no injury having ever been sustained, it was deemed unnecessary to continue the buoys. The shoal is a small ridge, very narrow on top, falling rapidly on both sides, and the depth on it has continued nearly the same for the last three years; it lies from Poolbeg Lighthouse N.N.W. distant 360 feet, and from the Great North Wall distant 800 feet; the channel north of it, which is that generally used, has a depth of 16 feet and upwards at the low water of spring tides, and the South Channel a depth of 12 feet and better, both sufficiently wide to admit of any vessel working into the harbour.

In the report before referred to, I have considered how far the present river navigation is capable of such improvement as would render it a suitable passage for the commerce of the city, whether a ship canal be necessary, and how far the various estimates for such a project would be adequate for its completion.

A survey has been making of the channel between the Pigeon House and the North Wall; the weather has prevented its being carried as yet sufficiently into detail; it will, however, in some measure, serve to show what has been done, and what still remains to be performed.

I have, &c.,
GEORGE HALPIN.

John Cossart, Esq.

SIR, *Ballast Office, Dublin, 5th March,* 1833.

As directed we have read the paragraph extracted from the memorial to the Lords of His Majesty's Treasury, from the London and Dublin Steam Marine Company, and beg leave to report to the Board:—

That it is our opinion that the excavation now making, to deepen the channel between the Pigeon House and North Wall Point, has by no means rendered the passage more difficult or dangerous; on the contrary, we think it a great improvement, it giving a deep waterway for its length, and may be used for vessels to anchor in when too late on the tide to pass up to the docks or quays, and as it is regularly buoyed can cause little danger to vessels where proper care is taken.

We are not aware of the accidents said to have taken place, viz., that a vessel grounded during the night and fell over on her beam-ends into one of these excavations, on which a brig belonging to Youghal, and a Scotch vessel, having struck, were sunk. We have made inquiry of the pilots, and of the masters of several colliers, but could not learn that any such accidents have occurred; and it is not probable they could have happened without our knowledge, nor have we heard of any accidents of a like nature.

Vessels passing without a pilot or experienced person on board may, now and then, ground unevenly, owing to the dredging work being as yet unfinished; but it must result from ignorance of the channel, or carelessness on the part of those on board. We are not aware of any vessel having thus been seriously injured.

The steam vessels of the memorialists may sometimes have taken the ground when the deepest channel has been filled by other vessels, but we cannot learn that they have in any case suffered serious injury from the inequalities of the dredging holes.

We are, &c.,
J. GRANTHAM, *Pilot-Master.*
THOMAS PHEPOE, *Harbour-Master.*
ALEXANDER DONAL, *Harbour Master.*

John Cossart, Esq.

SIR, *Ballast Office, Dublin, 11th March,* 1833.

Having laid before this Board your letter of 21st ultimo, transmitting a memorial of the Directors of the London and Dublin Steam Marine Company on the subject of the navigation of the River Liffey, and the expediency of making a ship canal from Kingstown, and requesting that a report should be given by this Board on the allegations therein, for the purpose of being laid before the Lords Commissioners of His Majesty's Treasury.

I am ordered to state to you in reply, that the Board is happy to have this opportunity of laying the required information before their Lordships, and of offering an assurance of their readiness to add any other detail which may be deemed useful. They have at all times felt it incumbent on them, and particularly so at present, to satisfy His Majesty's Government, as well as the public at large, that the duty confided to them has been performed with the utmost vigilance and fidelity, and with the aid of the most eminent skill they could procure.

The subject matter of the memorial has been very lately under their consideration, a similar one having been presented to his Excellency the Lord Lieutenant, and its allegations and the plan of a ship canal having been very fully discussed at a meeting of the Council of the Chamber of Commerce of Dublin, held for that purpose, and the inspector of works having been on that occasion directed to draw up a comparative report of the state of this harbour, as formerly and at present circumstanced, which, it is conceived, gives much of the information required for their Lordships. I now have the honour to enclose a copy. I also beg to enclose a copy of a report made by the inspector of works subsequently to the receipt of your letter, together with one from the pilot and harbour masters, relative to the accidents to vessels alleged by the memorialists, and I am to request you will submit these documents to their Lordships.

A reference to them will show what has been, even within the recollection of almost every one, the miserable condition of the port of Dublin; its dangerous bar, passable only at top of tide; the insecure and

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limited anchorage within, where vessels of any material size were obliged to be lightened before they could attempt the narrow and shoaly channel, through which the unsafe lying in the river and its ruinous places of discharge were to be reached; and their Lordships will afterwards find what has been already effected in the removal of those evils, so destructive to life and property, and so discouraging to trade. By the means of the Great North Wall a deep and direct channel is now formed across the bar, having water capable of floating a class of vessels formerly unseen in this port The anchorage within is extended, and safe for shipping, should it be requisite after their arrival, to delay their progress to the place of discharge. The various shoals are to a considerable extent removed, and every remaining obstacle is daily decreasing, either through the accelerated force of tide, or the application of powerful steam-dredges in addition to the ballast lighters. The New Quay walls now afford good moorings and commodious places for unloading and taking in cargoes, and the inequalities and dangerous matters which occur in the bed of the river, particularly after floods, are carefully removed. A patent graving slip, for the repairs of the large-sized steam and sailing vessels which now frequent the port, was provided at the earnest solicitation of the merchants and ship-owners, so soon as it was manifest that such an accommodation would not be constructed by individual means; and at the present moment the most energetic measures are taking to keep equal pace at every point, and to complete a farther deepening of the channel, so as to afford an uninterrupted course, at any time of tide, for the great majority of vessels now trading to the port.

The memorialists allege that the works carried on by this Corporation "have failed to realize expectation." How far their expectation extended is not stated, and the Board therefore are unable to admit or deny that fact. But this summary of existing evils, which, considering the avowed object, must be assumed to be the whole case that can be made out, is so short of those formidable ones which at no distant period caused a waste of life and property, and paralyzed enterprise, and are now so happily mitigated, if not altogether removed, that the Board cannot discover in the memorial sufficient grounds for abandoning the port of Dublin, and adventuring public money in the speculation of a ship canal. In this opinion they feel warranted by the judgment of every experienced ship-owner and merchant they have been able to consult, and that of the intelligent engineers that have been hitherto called on.

Their Lordships will observe that the Board have had an investigation made of the accidents alleged to have taken place; though great doubts exist as to their "frequency," which would not, it is conceived, as the memorialists affirm, on that account "cease to attract attention," it is to be regretted that accidents will be possible, through carelessness, in the very progress of improvements; and notwithstanding the persons employed have used every precaution within human foresight. The Board wish that their Lordships shall have their respectful assurance that the utmost pains are taken to call the attention of masters of vessels and that of the pilots to the warning buoys, and also that every exertion is making to finish those parts of the excavations in the channel which are likely to be the means of injury.

I have now to express the confident hope of this Board that, in fulfilling your request, the foregoing observations will, at the same time, serve to evince to their Lordships the zeal which is felt in this Corporation to promote the improvement of the port of Dublin, and to bring before their view how much has been already successfully executed, and the encouraging prospect in a consistent and rigorous prosecution of the present measures.

I have, &c.,
JOHN COSSART, *Secretary*.

Right Hon. T. S. Rice.

No. 13 (*a*).
Letters from Shipmasters respecting the bad Quality of Ballast.

No. 13 (*a*.)

Letter from Shipmasters respecting the bad Quality of Ballast.

Dublin, 21*st Nov.* 1843.

GENTLEMEN,

We, the undersigned, owners and masters of vessels constantly trading to this port, respectfully beg leave to state that the ballast at present delivered on board our vessels is of a very bad description, and in the event of our falling in with bad weather at sea, becomes complete puddle by the working of the ship, thereby being liable to cause the loss of our vessels and lives. Feeling confident that it is only necessary to make the circumstance known to you to have it remedied,

We are, &c.
(Signed by about seventy shipowners and shipmasters.)

To the Corporation for Preserving and Improving the Port of Dublin.

No. 14.
Halpin's Observations relative to the Channel of the River Liffey.

No. 14.

General Observations relative to the Channel of the River Liffey, Dublin Harbour, as shown in the Charts of the Years 1751, 1800, 1819, *and* 1838, *by* MR. GEORGE HALPIN, (Jun.) C.E.

Ballast Office, Dublin, March, 1845.

IN submitting the following observations relative to the accompanying charts, it has not been proposed to make a detailed report, either of the state of Dublin harbour, at the periods named, or of the various works executed for its improvement, or of their effects. My chief object having been to note down, from each map, such marked features of change in the channel of the Liffey, from its sea-bar to its quays, as would facilitate comparison.

It has appeared sufficient for this purpose to select four charts,—M'Kenzie's of 1751, Bligh's of 1800, Giles' of 1819, and Frazer's of 1838,—the last of these may, for general reference, be viewed as representing the present state of the harbour; although improvements by dredging and other works have been continued to the present date, and that some of the inequalities in the channel shown on it have been removed.

M'Kenzie's chart of 1751 enters so little into detail, is so mere an outline of this bay, that it has been introduced solely as interesting for comparison. On it, in the east channel of the bar, the depth marked is eight feet. In the channel to eastward of the Lighthouse, nine feet. In the anchorage at Poolbeg, 12 feet: the channel there being, at that time, much narrowed by the projection or spit of the North Bull Sand. Proceeding westward, in the anchorage outside of the Pigeon House, a depth of nine feet. In the channel abreast of the entrance to the Pigeon House Basin, six feet, shoaling to three feet abreast the western angle of that basin; and the only depths marked to the westward of that point, are depths of two feet, in the whole reach up to the quays of Dublin, a length of more than one mile and a half. It may be well to observe here, that the depths stated in those observations are from or below the level of the low water of a spring-tide.

Bligh's survey and chart, in the year 1800, is much more important than the preceding map, especially as his attention had been given to the subject of the improvement of the port, which he surveyed and carefully examined. On his chart, the depths marked are:—On the east bar, which then crossed in a curved form the direct entrance, five feet; in the south bar channel, seven to eight feet; in Poolbeg anchorage, 12 to 14 feet; on the Ford, between Poolbeg and the Pigeon House, four feet; at the Pigeon House, three feet; opposite the entrance of the Pigeon House Basin, seven feet, with a small space of greater depth; abreast the western angle of the Pigeon House Basin, seven feet; and in the channel thence to the quays, depths of only two feet: the shoalness in this upper reach it far corresponding with that shown in M'Kenzie's map of 1751. A deficiency of depth which then rendered it absolutely necessary that even the small class of cutters and sloops employed in the cross

No. 14.
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Channel Packet Service, should sail from the Pigeon House; and that fully laden vessels, unless of small size, should discharge part of their cargoes into lighters at Poolbeg, before passing up to the quays; and vessels, after having taken in cargoes at Dublin, were then frequently neaped there, and obliged to await the spring-tides.

Between the time of M'Kenzie's map, and that of Bligh's survey, a change appears to have taken place in the relative depths of the eastern and southern channels of entrance at Dublin Bar. The southern channel being marked as from two to three feet deeper in the year 1800 than the eastern channel; which greater depth in that southern channel is observable at a later period.

The next survey of importance was that made for the Ballast Office, in 1818 and 1819, by Mr. Giles. It was performed with the ability and care for which he is noted, and was carried into a degree of minute detail that could only be warranted for engineering purposes, and as forming the chief basis or standard with which to compare previous or following surveys. On it, as on Bligh's chart, the bar is shown extending from the North Bull across the direct line of entrance to the river. The depths marked on the east channel of the bar, are six feet and a half; in the southern channel of entrance, which was narrow, circuitous, and led close to the South Bull Sand, eight feet; within the curve of the eastern bar, ten feet or more. In the anchorage at Poolbeg, 12 to 15 feet. At the Ford, the greatest depth was seven feet, and that only in a narrow passage close to the North Bank, the shoal itself crossing the channel. In the anchorage near Pigeon House, were depths of from 12 to 15 feet. Abreast the entrance to Pigeon House Basin, nine feet; abreast of the western angle of the Pigeon House, five feet; and in the reach thence to the quays were extensive shoals crossing or barring the channel. On one of those, 2000 feet in length, were only from two to three feet in depth, and considerable lengths had but from three to four feet in depth. The few portions of greater depths being little, if at all, available for the purposes of the navigation. The altitude between the levels of low water and high water of spring-tide, to which Mr. Giles' soundings were reduced, was 13 feet.

The valuable survey of 1819 formed one of the preliminaries to important measures subsequently adopted for the improvement of the harbour. The Corporation for preserving and improving the Port of Dublin then determined on, and have since consistently and successfully carried on a series of operations, for the beneficial results of which we may refer to the public chart next in succession.

The Admiralty Survey of 1838, which is in amply sufficient detail for the use of the navigation, shows a marked change and improvement to have been effected since the time of the preceding survey. In the east or direct channel of the bar, the least depth marked is 11 feet at the low water of spring tide (giving a depth of 25 feet at high water). And it has already been remarked, that the depth in that east channel was, in 1819, only six feet and a half; and in 1800, only five feet at low water; and in this, now the main channel, there is not only the increased depth, but considerable increase of breadth, with a direct passage to seaward through the sand, which had formerly been part of the curved bridge of the bar. From the bar to the Lighthouse, depths of from 12 to 15 feet (being from 25 to 28 feet at high water). In the anchorage at Poolbeg, depths of from 13 to 15 feet. On the Ford Bank, depths of 10 to 11 feet (or 23 to 24 feet at high water), where Giles found only a narrow passage of seven feet, and Bligh only four feet at low water; the channel now being wide and direct. In the anchorage westward of the Ford, depths of from 14 to 17 feet (or 27 to 30 feet at high water). Abreast the entrance to the Pigeon House Basin, a depth of nine feet; abreast the western angle of that basin, 10 feet; and thence up to the quays of Dublin, formerly a long range of shoal, on much of which the depths were from two three feet, there appears on the chart of 1838, a channel from eight to 10 feet, (or 21 to 23 feet at high water,) with a few small patches of from six to eight feet, over which dredging has since been carried on; and subsequently to that date of 1838, further improvement of the channel has been in continued progress by excavating by steam-dredging; and at the quays increased accommodation has been provided for steam-vessels and other shipping.

The improved state of the channel of the Liffey, since the year 1819, having been adverted to, it may be relevant to state briefly the principal means whereby it has been effected. It was attained at the outer entrance or bar channel, through the direction and force given, by the formation of Northern or Clontarf Pier, to the discharge of water during the ebb. And in the river between Poolbeg and the quays, the deepening was made chiefly by steam-dredging, in some measure aided by the increased velocity of the current.

In 1819 the northern breakwater was determined on by the Ballast Board, after mature deliberation, and with the sanction of some of the most eminent engineers of that time. The position then given to it was, in 1819, planned by Mr. Giles and by Mr. Halpin.

In 1821 Mr. Telford was consulted, and reported his approval of the work, with which considerable progress had then been made. And in later years, after experience of the effects attending its construction, similar opinions have been given by other distinguished engineers, among whom it may suffice to name Mr. Cubitt. However, of the adaptation of this breakwater to the previous state of the harbour, in which the southern pier had been built, and of the successful attainment of the contemplated results, the charts sufficiently testify. The pier has nearly a S.S.E. direction from the Clontarf shore towards Poolbeg, and is in length more than one mile and a half.

It would be out of place in these general remarks to enter upon description of more than the already specified result in the formation of a considerably wider and deeper channel, direct from the river to seaward, in lieu of the former narrow, circuitous, and dangerous southern passage; a change consequent upon which, there has been for many years past a total freedom from wrecks at this bar. In observing which, it is not intended to undervalue the importance of Kingstown Harbour as an asylum. The effect of the north pier has not been limited to the bar channel eastward of Poolbeg, within the basin of which it forms one of the boundaries; the projecting spit of the North Bull Sand has been much reduced, so far increasing the width of the channel.

At the Ford Bank, the present channel was formed by dredging; and in thus making a direct and comparatively wide and deep passage, by leaving a free course to the stream, the tendency to deposit at that place has been removed.

Excavation by stream-dredging has also been carried through the whole length from the Pigeon House to the quays of Dublin, both in the best channel and along the projecting edges of the banks on either side, with such advantage, that it is of almost every-day occurrence to perceive sloops and small schooners passing up to the quays at low-water neaps, which formerly should have waited until nearly the time of high water; and examination of the charts, and of the section annexed, (being No. 6 of the maps sent,) will show that, on continuing throughout the depths already obtained in much of its course, the river will be navigable, at low water, for the greater number of vessels trading to the port.

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No. 14.
Halpin's Observations relative to the Channel of the River Liffey.

But even the present state of the river and harbour, formed within the moles, will appear satisfactory, contrasted with that described in the Parliamentary Reports made before the commencement of the operations of the last 25 years. In one of these Reports it is set forth, "That even at the height of the tide, the Liffey has only 13 feet water in many places which yet must be passed over before merchant vessels can enter;" and one well informed of the state of Dublin Harbour in 1805, writes, "That vessels drawing more than 10 feet water, are not fit for the trade of Dublin; and those have, on an average throughout the year, but six hours out of the 24 they can enter it." And it is matter of record, that, in six years from 1797 to 1803, 124 vessels were wrecked or damaged in the bay or harbour, many of those within the river, after coming to anchor in parts now well sheltered in all winds.

In contrast, indices will also be found in comparing the levels of the bed of the river with those of the sills of the different dock entrances. One of the Parliamentary Reports, before alluded to, describing Dublin, mentions that "It has docks and canals, with a prospect of extensive ramifications from them, but the door to them is shut." Whereas now the bed of the river, taking the shoal parts of the channel, is several feet below the lowest of those sills. Other indications, though of very minor weight, may be had in the discontinuance of the large merchant lighters formerly used for taking out at Poolbeg, or to the eastward of the Pigeon House, part of the cargoes of vessels about to proceed to Dublin, or in completing the loading of outward-bound vessels when to the eastward of the shoals.

The various works executed for the Corporation for improving the port, in the erection of cut stone quays, some miles in length, in lieu of the old rubble walls, the building of several bridges, and of two graving slips, having been treated of in other reports, it is unnecessary now to repeat mention of them; and it only remains to be stated that, since the year 1840, a frontage or wharfage 1,400 feet long, has been constructed at the North Quay, in front of which there is a depth of nine feet at low water. At the space now occupied by the eastern half of this wharfage, the London and Dublin steam-vessels were, only a few years since, often obliged to discharge by long gangways, and were occasionally altogether detained through want of water during the neap tides.

Screw moorings have, within the same period, been put down in the anchorage at the North Wall, and in those parts of the river where most required.

There has not been, that I am aware of, any formal complaint of the general state of the harbour, as regards large works for its improvement, during the last few years. With respect to complaints formerly urged as to want of a sufficient depth of water, and as to inequalities in the bottom of the river, the documents published by the Ballast Office, in 1833, afford explanation. The chart shows what has subsequently been effected in removing the alleged cause of those complaints; and I may add, that portion of the funds applicable to the improvement of the harbour being derived from the sale of ballast to shipping, it has occasionally been found necessary, when clear shingle ballast could be had, to excavate for it to a depth and in a direction that would not have been otherwise attempted. But each year some readily perceptible improvement has been made in the navigable channel, and some additional work performed for the convenience and security of vessels in the port.

In concluding, I shall briefly recapitulate what has been effected since the year 1820. A direct and comparatively deep and broad channel has been formed through the bar. The shoals at the Ford, and between the Pigeon House and the quays, cut through, making a channel, from the deep water outside of the bar up to the wharfs and docks, which is now daily passable by vessels that could not formerly have entered at high water of the greatest spring tides, and is navigable at half-tide by a class of vessels that formerly could not, without much difficulty, have passed at the high water of neap-tides. Cut-stone quays have been built in place of the old rubble walls. Graving slips have been constructed, and a considerable length of wharfage made, and now used by steam-vessels, which from their length and weight were most liable to receive injury from strains. And there has been accumulated an effective establishment of steam-dredges and punts or floats, by which to extend the plan followed, and from which such practical advantages have accrued, which admits of the facile addition of docks and slips, and by which the port may be rendered fully adequate to the requisitions of its increasing commerce.

In noting down imperfectly the foregoing remarks, I am aware that there have been several repetitions which it has not been sought to avoid, my wish having been to claim attention, as far as lay within my power, to actual improvements. There have also been purposed omissions, such as consideration of the connexion of the Asylum Harbour of Kingstown with the Port of Dublin, which will, no doubt, be better supplied from another source. I have also avoided notice of the various projects (some of them very crude) for undertakings within the Bay of Dublin, and mention of the theoretic opinions, whether of others or my own, as to the precise mode of operation, whereby changes have been made; or speculations as to the probable future alterations. And I have aimed, as far as the subject would admit, to confine myself to the course expressed at the outset, namely, to furnish some comparative observations on certain charts of the Harbour of Dublin.

GEORGE HALPIN.

Ballast Office, Dublin, March, 1845.

No. 15.
Macneill on an improved entrance to Grand Canal Docks, and turning the course of the river Dodder.

No. 15.

Report by Sir JOHN MACNEILL, C.E., *on an improved Entrance to the Grand Canal Docks, Dublin, and on turning the course of the river Dodder.*

GENTLEMEN,

Dublin, 5th March, 1846.

The extraordinary pressure of railway business has prevented me from sooner applying myself to the important subject submitted for my consideration and report, in the letter addressed to me by my friend the Secretary of your Company, on the 3rd November last, requesting that I should submit to you, for your information and guidance, my opinion upon the plan originally designed by him for an improved entrance to your extensive floating and graving docks at Ringsend, with the formation of a tidal basin, to occupy the large space of waste ground between the floating dock and the river, and also the mouth and present bed of the Dodder, which latter it is proposed should be turned out by a new course, so as to discharge itself on the strand of the South Bull.

I have also to acknowledge your further instructions, that I should have soundings made with strict accuracy, and corresponding sections furnished of the channel forming the present approach of the two principal locks by which vessels enter the floating basin, and also of the bed of the river Liffey, opposite to and for some distance above the entrance, with a view of satisfactorily refuting an erroneous statement which had been extensively circulated, to the effect that the lower or entrance sill of the principal

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(Camden) lock was from seven to eight feet higher than the bed of the river, and that your docks were consequently inaccessible except to vessels of a very light draught of water.

The soundings so directed I have now to acquaint you have been made by one of my principal and most experienced assistants, under my own immediate direction; and the several sections showing the results, and which have been made with very great care, I have the honour to transmit for your information. The result cannot be otherwise than gratifying to you, as you will observe that the floor of the chamber of the Camden Lock is as low as the deepest portion of the centre of the river opposite, and, as you will also observe, lower than the bed of the river at several points upwards. In reference to these particular sections it may be stated, that they clearly establish the important fact, that there is a sufficient depth of water on the sill of Camden Lock for any vessel which could either sail up the river, or approach the lock through the present dredged channel.

From observations simultaneously made at Camden Lock. and at the entrance to George's Dock, Custom House, I find that the depth of water on the sill of Camden Lock exceeds by about one foot six inches the depth on the entrance sill of George's Dock.

In reference to the plan originally designed by Mr. M'Mullen for an improved entrance to the docks, with an extensive tidal basin, and embracing the important object of turning out the Dodder upon the South Bull, I can have no hesitation in expressing my entire and unqualified approval of it. At the time it was first suggested and brought forward, I was much struck with its simplicity and the extraordinary facilities which everywhere existed for carrying it into effect, and I had much pleasure in rendering Mr. M'Mullen any assistance in my power, and in affording such suggestions as occurred to me, with the view of improving and forwarding it.

It is impossible to cast the eye over your Company's splendid floating basin, covering, as I understand, 25 statute acres, with a depth of water which, I find, is now steadily maintained at a depth of 18 feet or thereabouts, without a feeling of great regret that facilities such as are thus offered both for the foreign and the coasting trade of the port of Dublin, and the important adjacent districts, should not be as available for the advantage of that trade as they unquestionably can be rendered, and for the accomplishment of this most desirable object I freely admit that I have seen no project or plan at all comparable to that now before me, either as to the extent of the advantages which it is calculated to secure, or the comparatively small cost at which it is capable of being executed.

Of the several operations which the carrying out of the project involves, there is none the necessity for which is so manifest, or the cost of which would be so trifling, compared with its importance, as the turning out of the Dodder upon the South Bull. Sections No. 1 and 3 show the enormous deposit of silt which it carries down and lodges in the channel opposite the entrance to the docks. The dredging out of the narrow and, as yet, quite inadequate channel, forming the approach to the Camden and Buckingham Locks, and of that portion of the river immediately opposite, has this year, as I am informed, occupied the two powerful steam-dredgers of the Ballast Corporation for a period of about two months, at an expense which cannot but be very heavy, and which must recur annually and inevitably after the winter floods, so long as the river is allowed to remain in its present course. The necessity for an improvement so obvious has been long felt. It was recommended by the Irish House of Commons on various occasions, and attached to their proceedings of 26th February, 1785. There is a ground plan of the new course into which it was proposed the river should then be turned, which scarcely at all differs from that laid down in the present plan (Irish Commons Journals, vol. 22, p. 627); and this was further followed up by the enactment contained in the Act creating the present Ballast Corporation (26 Geo. III. c. 19, secs. 83 to 90), by which the Directors of that Corporation are authorized, in terms which the Act sets forth at great length, and conferring the most ample powers, to carry out and complete the measure. In accomplishing it there is no actual necessity for the removal of the present weir, although this would render the results more useful to the adjacent grounds, and, in this case, a supply of water for the neighbourhood could be readily obtained from the river above Ball's Bridge, and a reservoir formed on the site of the bill pond of the old distillery, as sketched on the plan. I have examined the ground which it is proposed the new course should occupy; in length it is about 600 yards. The Act referred to prescribes that the new course shall be "of the width of 68 feet at least in the bottom, with sufficient embankments on each side." In order to ascertain the cost of completing the work in conformity with these dimensions, in a thoroughly permanent and substantial manner, I have had a survey and section of the whole carefully made, of which I herewith enclose a copy, together with an estimate of the entire, including the purchase of the ground and of three newly-built houses, which it will be necessary to remove; the building of the bridge, construction of the embankments, sea-wall, &c., amounting in all to 5691*l.* 6*s.* 8*d.*, a sum which, compared with the importance of the work, and the benefits which its being carried out will confer upon the Port of Dublin, must, I apprehend, appear very moderate.

In turning to the plan for the formation of the tidal basin it is impossible not to be struck with the fact—and it is one of manifest importance—namely, how much of the work *has been already done*, and how little for the realization of the whole project remains to be accomplished; whilst of this latter the entire is of the plainest every-day character, and quite free from anything which could be regarded as an engineering difficulty. The whole is, in fact, comprised in the excavation of the ground, the extension of the present south wall and quay, the lining of the interior of the basin to be excavated, with cut stone facing, well puddled, and the construction of the entrance gates. The proposed lock for the admission of steamers of the largest class to the upper basin does not appear so indispensable to the successful working of the plan as to call for its being immediately undertaken. It may be prudent to wait the result of the trials of the screw propeller now in progress; and in the meanwhile the outer basin will afford a very large amount of accommodation to the largest class of paddle steamers. In reference to the excavation of the basin, it is well deserving of notice that the ground inside of the Queen's and the other adjacent timber-yards is greatly below the level of the quays and of high water, and that the material excavated may be not only very beneficially and usefully deposited in these yards, but that the close proximity of such a place of deposit will be a source of considerable economy in carrying out this part of the work.

As regards the convenience of the shipping of the port, the portion of the project which, beyond every other, would seem to recommend it to public favour and approval, is the position of the entrance to the tidal basin in a right line with the direction of the river—a fact so manifestly important, and calculated to afford facilities both for ingress and egress so obvious, that it is quite unnecessary to enlarge upon it.

I have not entered into any calculations with reference to the costs to be incurred in forming the tidal basin and the proposed entrance to it; a detailed specification and estimate of the work having been made in the year 1840, apparently with great care and minuteness, by your Company's late engineer, John Stokes, Esq., which has been placed in my hands. I have looked attentively into it, and I find the prices are not only amply sufficient for the execution of the work in the best and most durable manner, but, in some instances, higher than contracts could now be obtained for completing it. The detailed specification is in the hands of your Company's secretary, showing the entire estimated cost to be 35,484*l.* 5*s.* 4*d.*

It will be necessary to continue the main sewer, by which the water is at present discharged from the graving docks, at a sufficient depth under the bed of the Dodder, to the opposite or Ringsend side of it, to be carried in a direction parallel with the bank of the river down to the Liffey, east of the dock entrance, there to discharge at the level of low-water spring tides, and which sewer can also be made available for unwatering the low ground south of the docks.

The last in order of the various points to which, in considering the whole of this question, my attention has been drawn, is one which, especially in an engineering point of view, I regard as not only most important, but highly interesting. It is indicated on Mr. Macmullen's plan, but not on a scale, in my mind, sufficiently extensive to accomplish the object which I would contemplate. I allude to the breakwater which he proposes should be formed from the point at which, by the new course, the Dodder would be discharged upon

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the South Bull, across to the great south wall, with an opening in the latter for the outflow of the water retained within this barrier at each ebb of the tide, and through which opening it would consequently be discharged into the channel of the river which forms the sailing course, and where it would necessarily act as "a scour" in regard to that important portion of the entrance to the harbour. Of the soundness of the principle and the beneficial effect which would in this way be produced there can be no doubt; but to render it as effective as the general condition of this portion of the sailing course would appear to require, it must, in my opinion, be carried out on a considerably more extensive scale; the mound to be raised commencing, in any case, as far eastward as the Pigeon-house, and terminating at or near to the martello tower on the Sandymount strand. It does not seem necessary that the proposed barrier or mound should be raised to any considerable height, as the effective action of the scour would occur as the ebb tide approaches to low water. I think that a sufficient mound or barrier could be formed, of such a height as I contemplate, from the heavy clay and gravel of which the strand in this part of the bay consists, at a very moderate expense. The bridge to form the opening in the south wall for the efflux of the water, of whatever number of arches it may consist, should be at the least from 250 to 300 feet wide.

Of the cost of this part of the work I have not framed nor submitted any estimate; it is plain, however, that, with reference to the importance of carrying out such a project, it could be, comparatively speaking, but inconsiderable.

A glance at the present state of the bay shows that as far eastward as the Poolbeg light, it is divided by the great south wall into two nearly equal portions. The effect of the great *north* wall has been to cause the ebb water of the northern division to act upon the bar, and, in this respect, it has abundantly answered the expectations entertained by its projectors. If, in addition to the important and valuable action so obtained from the northern section of the bay upon the bar, it shall be practicable in a similar way to impound the tidal waters of the southern division of it, and, as I confidently contemplate, to produce from their efflux, a corresponding beneficial deepening action upon the continuation of the bed of the river, forming the entrance channel to the inner harbour, a result will have been obtained of the most decisive character, not alone as regards the facilities of access and the safety of the shipping frequenting the port, but calculated also to diminish to a very large extent the cost annually incurred in dredging out of this channel the vast quantity of silt and mud which, under present circumstances, is and must continue to be deposited in it.

It is not to be overlooked that a proceeding is at present in progress, under the direction of the Ballast Board, which, if carried out to the extent apparently contemplated, would offer a serious obstacle to the important improvement now suggested. A wall has been built at the back of the south wall, parallel to and about 90 yards south of it. Within the space so enclosed the material dredged from the bed of the river is now in progress of being deposited. If this new wall shall be continued so far westward as to close in with the high ground of Ringsend, and the intervening space be filled in, a suitable channel to that part of the south wall, where the contemplated bridge or opening for the efflux of the tidal water into the bed of the river should be formed, would be impracticable. I cannot doubt that, if a proper representation were made to the Ballast Board, any further proceeding calculated to produce this result would be stayed until at least time should have been given for a full and serious consideration of the plan now submitted.

To the Directors of the Grand Canal Company. JOHN MACNEILL.

KINGSTOWN.

No. 16.
Rennie on an Asylum Harbour in Dublin Bay.

No. 16.

KINGSTOWN HARBOUR.

MR. RENNIE *on the Site of an Asylum Harbour in Dublin Bay.*

MY LORD AND GENTLEMEN, *Dublin, 22nd May,* 1817.

The railway from the hill of Dalkey to Dunleary being now nearly completed (except the branch to the Mine Valley), and it being your intention to commence the works of the new pier immediately, it becomes my duty to lay before you such observations as have occurred to me respecting the best situation for commencing the works.

The harbour of Dunleary is proposed to be one for the asylum of vessels trading to the port of Dublin when embayed in strong easterly gales, at times when there is not a sufficient depth of water for them to pass over the bar into the harbour, and also in dark nights and stormy weather, when, from damage done to them, they are unable to enter it in safety. It is likewise to be considered as a rendezvous for His Majesty's cruizers in the channel, and for merchant vessels driven into the bay by stress of weather; as far, therefore, as the first class is considered, namely, the merchant vessels trading to the port of Dublin, the further the harbour is placed to the westward the more likely such vessels are to steer a course into it, but with regard to His Majesty's cruizers, it would be more suitable if placed more to the eastward, as well as of vessels driven into the bay by stress of weather, as the two latter classes would seldom come to an anchor, but would shape their course directly for this asylum harbour, under the pier of which they would find safe anchorage and shelter.

The space on which such a harbour could be constructed with propriety, is, however, limited; on the west, by the shallowness of water, and on the east by the rocks at Lundy Cove, Bullock, and Dalkey. It appears by the soundings in the plan which accompanies this Report, taken at low water of a spring tide in the direction of about north-east from the head of the present pier at Dunleary, that there is eight feet, and the depths gradually increase outwards to about 19 feet at the distance of 1,000 yards from the said pier; that from the soundings taken in a north-westerly direction from the pier-head, towards the South Bull, there is only 10 feet for the distance of about 500 yards, after which the soundings gradually decrease to the South Bull. In a line parallel to the last-mentioned line, and at the distance of about 1,000 yards from the old pier, the water gradually decreases to 17, 16, 15, and 13 feet to the westward, and from thence to the tail of the South Bull; and, therefore, were an asylum pier to be constructed, commencing at the old pier, this would by no means give a sufficient depth of water for vessels to work under its shelter, or keep them afloat at low water, independently of the great risk they would run of being thrown on the South Bull and wrecked.

The objections I have enumerated have led to the idea of constructing the asylum pier about 800 yards east of the head of the present old pier at Dunleary, which would not only give so much more sea room between the north-west end of the pier-head and the South Bull, but would also afford a greater extent of deep water under the shelter of the pier itself; a pier, therefore, constructed at the place I have named, would be much preferable to one departing from the old pier. The place at which it should be constructed, will, however, depend on circumstances which I will now proceed to detail.

The pier represented on the engraved plan is well situated for the trade of Dublin, but it appears that the water is much deeper in the line of pier itself than about 160 yards further to the westward; a question will therefore arise, namely, whether a pier placed 160 yards west of that represented on

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the engraved plan would not suit the trade of Dublin itself, as there would be nearly the same depth of water at its head, and the general depth sheltered by the pier would be little short of the depth marked on the engraved plan?

It would likewise occasion a saving of about 19,700*l.*, and the pier-head would be in the proper place for vessels to run from the anchorage where the merchant-vessels now lie to obtain its shelter, while it would be convenient, when wind and weather suited, to let loose and run for the pier of Dublin; but although it would possess these advantages, the sea room for vessels to work into it would be abridged, and there would not be a sufficient depth of water within it to give shelter to any ships of war larger than a 32-gun frigate, and scarcely even for a vessel of that size; so far, therefore, as regards the Royal navy, its benefits would be very limited.

To answer the purposes of giving shelter to His Majesty's navy up to the size of 36-gun frigates, as far as the nature of the case will conveniently admit, and without occasioning any very great additional expense, the pier ought to be placed at a distance of about 330 yards further down the bay than what is marked on the engraved plan, which will bring it to the Codling Rock. A pier built in this situation would generally have from 21 to 24 feet of water within it, and about 22 feet at the north-western extremity of the head at dead low water of a good spring tide; this would give a sufficient depth for frigates of 36 guns, and of course for all ships of a less draft of water, and would likewise answer the purpose of merchant vessels trading to the port of Dublin, and indeed would be very beneficial for East India ships, should ever a trade with India be established at that port, but this will occasion an extra expense over that which was proposed to Parliament, of 12,800*l.*, and over one, if placed 160 yards west of the Parliamentary plan, of 32,500*l.* The question then is, whether to gain so great an object the above extra sum ought to be expended? This is a question which I must leave to your decision.

I am aware that objections will be made to a pier placed so far down the bay, the principal of which will probably be, that the present anchorage for merchant vessels being to the westward of this pier, they would not be able, when overtaken by a storm while at their anchors, to work into the harbour. This objection, although it apparently carries great weight with it, will, I am persuaded, on examination, be found scarcely worth attention, for whenever a complete asylum pier is constructed, merchant vessels and colliers will seldom, if ever, anchor in the roadstead, but will at once run for and take shelter under the cover of the pier. If I am right in this conjecture, which I trust I am, the objection falls to the ground; in all other respects, except the extra expense, I have no doubt it will be found to be decidedly preferable.

I have, &c.,
JOHN RENNIE.

No. 17.

Lieut. HUTCHISON, R.N., *on Damage caused by Gale.*

No. 17.
Hutchison on Damage caused by Gale.

GENTLEMEN, *Kingstown, 5th January,* 1826.

I beg leave to submit to you a correct statement of the accidents that occurred in the Royal Harbour, during the late tempestuous weather.

At 2 P.M. on Friday, the gale at east, which had been blowing with great violence for the three previous days, increased almost to a hurricane, with a tremendous sea in the bay. Perceiving a brig running for the harbour, I went out to assist her in coming to an anchor, (there being at this time thirty vessels at an anchor, in shelter of the east pier, a list of which I subjoin). On letting go her first anchor, she drove, hooked the cable of the schooner "Violet:" both vessels were driving down on the revenue brig "Shamrock," but by the active exertions of my boat's crew and some pilots, another anchor was let go, the sails furled, and sufficient cable veered, when fortunately both vessels brought up, by which much mischief was prevented. The commander of the Shamrock sent men at my request to strike her lower-yards and topmasts as a further security. At 3 o'clock, while on board this brig, I observed that the American ship "Colossus," of 400 tons, was driving. I instantly went on board, and by veering a sufficient scope of cable on both anchors, and striking the lower yards, &c., she held on. At 3h. 30m. the schooner "John" hoisted a flag of distress; she was driving on shore with one anchor. I instantly dispatched boats for an anchor and cable, and to prevent her going on shore before they should arrive, I cut away her foremast, which as I expected saved the vessel. At this period (4 o'clock), the "Marian," of 360 tons, and "Letitia," of 350 tons, both timber loaded, and the outermost vessels (with the exception of a schooner, which never stirred during the gale), and who were merely affected by a heavy swell, which proceeded from the sea that raged at the point of the east pier, each carried away their largest chain cables, and the "Marian's" remaining anchor having hooked the "Letitia's" cable, both vessels drove rapidly towards the old harbour; the "Marian's" draft of water near 17 feet, she soon struck the ground. Both vessels made signals of distress, but the tide being out, and a considerable sea rolling into the boat harbour, not having any anchors of a sufficient size to be of use to them, and from the swiftness with which they drove, the impossibility of getting anchors and cables to them in time, and also my knowledge of the "Marian's" windlass being disabled (which prevented their veering cable on the remaining anchor when the other parted),—all these reasons combined made me decide upon going off to direct them to cut away their masts, as the only chance of saving either vessel. The master of the "Letitia" immediately complied, but the master of the "Marian" being absent, the mate would not do so: the result was, as might be expected, the preservation of the "Letitia;" the "Marian" drove on the rocks near the battery (now ship-yard), and when she ceased to drag the "Letitia," that vessel brought up. These vessels drifted down on the "Fame," schooner, "Elizabeth," sloop, and "William," galliot, some of whose cables they cut; the masters terrified, and to avoid apparent destruction, slipped their cables and run, as they hoped, for safety to the old harbour. The "Sampson," brig, having parted her cables, followed shortly after, but it being low water, with a violent swell rolling in, all these vessels grounded in the entrance; and although I had cables brought down to the pier-head to carry out, and if possible, heave them alongside the pier by the capstan from their perilous situation, their crews deserted them, and the boatmen were not in consequence inclined to exert themselves for their preservation. They soon bilged, and as the tide rose, they beat out their bottoms and went to pieces.

I have, &c.,
WM. HUTCHISON, Lieut. R.N., *Harbour Master.*

To the Commissioners of the
Royal Harbour of George Fourth.

N.B.—The violence of this gale caused so much sea, that the works in east pier were stopped several weeks, to relay the tram-road, &c., and repair the breaches made in the wall by sea.

APPENDIX B.

KINGSTOWN.

No. 18.
Rennie on completing the Harbour.

No. 18.

Mr. RENNIE *on the best Mode of completing Kingstown Harbour.*

London, 16*th June*, 1826.

GENTLEMEN,

In consequence of your having confided to my charge the chief management of the works now carrying on for the construction of the Royal Harbour of George the Fourth at Dunleary, I proceeded thither in the beginning of April last, and minutely inspected the whole of the operations. These have hitherto been conducted according to the original plan laid down by the late Mr. Rennie, and the East Pier has now advanced to the termination of the third kant, and the West Pier to about 370 feet beyond the termination of the second kant. Thus far this important harbour has been conducted well, and considerable benefit has been derived from the piers, even in their present unfinished state, both to the ships belonging to His Majesty's service as well as to all classes of trading vessels frequenting the Port of Dublin and the Irish Channel. The grand object now seems to be, what plan shall be adopted for its completion? This certainly is a subject of the greatest importance, and demands the most serious consideration; for upon a correct decision depends the success or otherwise of this great undertaking. I have, therefore, in compliance with your instructions, taken every pains to investigate the subject fully, in all its bearings, and have perused with great attention the different reports and documents which have been made in favour of the various alterations proposed, and beg leave to offer my opinion as follows:—

The general principle and utility of this harbour have been approved of by all parties, and the alterations suggested are chiefly confined to the following points: namely, the position, the dimensions, and the form of the entrance.

With regard to the first, it has been objected to the entrance, as laid down in the plan designed by the late Mr. Rennie, that it is too far to the eastward, and, in consequence, if executed according to that direction, the harbour, during easterly gales, would be so exposed and disturbed within, that the protection would be considerably diminished, and that vessels, unless provided with more than ordinary ground tackling, would be unable to ride in safety. To this it may be replied, that the present harbour is intended as an asylum during easterly gales for all classes of vessels, but more particularly for those frequenting the Port of Dublin, and as such it should present the greatest possible facility for entrance and departure; and by referring to the plan, it will be seen that this important object has not been neglected; but this would not be obtained, provided the entrance was to be placed further westward, because vessels in that case, during gales of wind (when they are most unmanageable), would in all probability be driven too far to the leeward, and would find it extremely difficult, if not impracticable, to work far enough to windward so as to enter the harbour, and would, consequently, be liable to be driven ashore and wrecked upon the South Bull, which could not take place with the entrance as originally designed, because it would be directly under their lee, and they would enter with a leading wind without difficulty. Moreover, as the prevailing winds are westerly, these, with a more westerly entrance, would blow directly into the mouth of the harbour, and would consequently prevent vessels from sailing when most advantageous to make their passage: so that, in fact, the harbour by the alteration, would become most difficult of access and departure, at *the very times* when most desirable that it should be otherwise. It may be argued that in consequence of the perfection of navigation by steam this objection would daily diminish, but it must be remembered that the same advantages and disadvantages apply to steam vessels, although not in so great a degree as to sailing vessels. Arguments similar to the above have been so clearly stated by the Commissioners in their letter to the Treasury, of the 5th of May last, that it is useless to argue them further. Moreover, such an entrance, by being exposed to the set of the various currents, which more or less agitate the sands in the bay, would be liable to receive them, and consequently to produce an accumulation of sand within the harbour, which in process of time might prove very injurious. The free flux and influx of the tide, into and out of the entrance, would also be checked by the opposing counter currents, which would tend still further to increase the deposit within, and to affect the preservation of the harbour. It has been argued that the water in this part of the Bay of Dublin is constantly clear, both upon the flood and the ebb. This, however, is merely comparative; and from the actual decrease of depth, or shoaling, in the upper end of the bay, there is every reason to believe that it is not so,—and every tendency of this nature should be most carefully avoided. Lastly, as the depth decreases to the westward by altering the entrance more in that direction, a depth of *three* feet of low water would be lost, which certainly is a matter of the greatest importance.

The apprehension that the harbour, if constructed with an entrance as designed, would be unquiet within, appears groundless; because the entrance being 430 feet wide *at the narrowest part*, any waves that might pass within would be so broken, and have such an extended space to disperse themselves over, that the undulation would be comparatively imperceptible, and certainly not of that nature to affect vessels provided with the ordinary anchors and cables. Independently of the space occupied by the entrance, there would be ample protection under the piers for more than the number of vessels that would be required. It is true, at times there are hurricanes which would drive vessels from their anchors even in a close dock. This, however, is a contingency not likely to occur; and if it did, this would take place under any circumstances. In this respect, therefore, the position of the entrance would make little or no difference. The accidents which occurred during the late gales have been adduced as an argument in favour of altering the entrance to the westward; this, however, will not apply; because, from the statement of Mr. Aird, it appears that they arose principally from mismanagement; and the opening between the present terminations of the piers is above 1,400 feet wide, and, consequently, little protection is comparatively derived against this quarter at present; but in proportion as the piers advance towards each other, this will diminish, so that no correct conclusions can be derived from the harbour until it be further advanced.

With regard to the second and third,—it has been objected to the dimensions and form of the entrance as designed by the late Mr. Rennie, that it is *too narrow*, and that the agitation that would be produced between the pier heads by the waves being reflected from one angle to the other would be so great as to endanger vessels whilst entering and departing from the harbour, and render them liable to be wrecked on the pier. To this it may be replied, that the narrowest part of the entrance is 430 feet, but that the width between the extreme angles—which in point of fact must be considered as the entrance—is 1,150 feet, and this consistently with the object of giving due protection within the harbour, forms a considerable opening, although this can be regulated by experience, and be extended hereafter to about 500 feet wide at the narrowest part, if during the progress of the work it shall be deemed advisable: and as to any agitation of the sea that may be produced between the piers, it may be observed, that the waves, by recoiling from one angle to the other, will be checked in their progress

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and reduced in violence, so that the centre for which vessels will naturally steer, will be comparatively tranquil; moreover, the recoil of the waves will prevent vessels from striking against either pier, so that they will be inevitably kept in the centre between the piers, and must enter the harbour without difficulty, whereas, without some precaution of this kind, there would be a heavy sea in the entrance during gales, and vessels would find considerable difficulty in steering clear of the piers; moreover, the run of the sea into the harbour would be considerably augmented.

This principle of an inclined entrance has been tried upon the old harbour at Whitehaven, and although executed very inefficiently, vessels during the most violent gales have never been known to strike against the pier; and as to any difficulty in departing from the harbour, there could be comparatively none, because the prevailing winds generally blow out from the harbour: and even supposing the winds should be adverse, they could lie out upon either tack, or might readily be warped out if the weather should be moderate enough to enable them to keep the sea when out of the harbour. Upon the whole, therefore, viewing this important subject impartially in all its bearings, it appears that every circumstance connected with it has been duly examined and considered previous to the determination of the present design, and although in the formation of harbours it is extremely difficult to avoid every objection, nevertheless, in the present instance I am of opinion that as much has been done as the nature of the situation will admit, and if executed accordingly, will be most likely to effect the different objects originally contemplated, namely, the formation of a complete Asylum Harbour. Upon these grounds I cannot recommend any material deviation from the plan already laid down, although during the progress of the work I shall not fail to avail myself of the circumstances as they arise, and report to you my opinion accordingly.

The principal object however, at present, should be directed towards advancing the western pier as fast as possible, in order to give protection to the interior of the harbour, and the last arm or kant of the eastern pier might be for the present deferred, which would give time for further consideration; but the necessity and advantage resulting from continuing it as originally laid down will, I have no doubt, become daily more apparent.

With regard to that part of your instructions which relates to the formation of the sea slope or face of the eastern pier, I have to observe that, provided the rubble has become sufficiently consolidated (and judging from the time that has passed since it was deposited, I should conceive that a considerable portion of that part of the pier towards the shore must by this time have in a great measure acquired its ultimate slope, I should recommend it to be formed in a more regular manner), in order to prevent occasional repairs in restoring the surface, which otherwise will probably from time to time be ripped up and pulled out by the violence of the waves. In commencing this operation, the greatest difficulty will be found in securing the base or toe of the slope, for when once this has been well effected, the remainder becomes comparatively easy; to secure the toe of the slope, therefore, I should recommend that a beaching or foreshore, varying in width according to circumstances, should be left in front of the slope; this foreshore will act as a barrier against the most violent waves, and prevent them from breaking upon the base of the slope, and will, moreover, enable the workmen to secure it more effectually; from thence upwards the slope should be carried on according to the general inclination already determined by the sea, which appears to be about five feet horizontal to every foot perpendicular: the stones for this operation should be composed of the largest description, roughly squared, and set at right angles to the slope, header and stretcher alternately, and well bedded into the rubble below. Upon this subject I had frequent discussions with Mr. Aird, when in London lately, and as he now understands the principle upon which this operation should be carried on, I should recommend that a portion of about 100 or 200 yards should be commenced upon that part of the eastern pier which is best adapted for the purpose, and in proportion as this proceeds the effect of the sea upon it will be seen, and the further progress of this work can be regulated according as circumstances shall render it most advisable.

I cannot close this report without offering my apologies that it has not been sent earlier, but I unfortunately have been prevented by indisposition; at the same time I am extremely happy that no inconvenience has arisen to the works in consequence.

I have, &c.,
JOHN RENNIE.

To the Commissioners of Kingstown Harbour.

No. 19.

Mr. RENNIE *on the best Site for a Landing Pier in Kingstown Harbour.*

No. 19.
Rennie on the best Site for a Landing Pier.

GENTLEMEN,

London, 29th June, 1829.

I have to acknowledge your letter of the 9th of April last, accompanied by two Memorials to the Lord Lieutenant of Ireland, praying for the erection of a Landing Pier for passengers, within the Royal Harbour of George the Fourth, together with Mr. Aird's report thereon; and you inform me that the Commissioners desire to have my opinion, together with a Plan and Estimate in duplicate for completing the work. I have accordingly taken the subject into consideration, and beg leave to make the following observations:—

That some additional landing place, as prayed for by the Memorialists, is necessary to accommodate the numerous passengers embarking and disembarking to and from the steam-boats which now carry on the extensive and continually increasing communication between Dublin, Liverpool, and various other parts of England, there can be no doubt, and has been long wanted, and the principal reason hitherto why the attainment of this very desirable object has been deferred is the unfinished state of the harbour, which has prevented the possibility of determining with accuracy the most advisable situation, as well as the precise kind of accommodation that would be required. It was in consequence of this reason alone that the Post Office, in the month of June, 1826, determined to erect only a temporary wooden landing jetty on the east pier, until the finished state of the harbour would admit of the adoption of some more permanent plan, which, for work of this description, has, I understand, answered very well; although, when the harbour is sufficiently advanced, a more permanent structure will probably be erected for the service of His Majesty's packets. The next question to be considered is, first, whether the harbour has not arrived at that state to admit of a proper decision for a permanent station; and if so, which is the most advisable place, and kind of construction for the purpose intended.

With regard to the first,—the outer piers have certainly not yet been carried to their full extent, and it might be inferred with some reason, that until that event has taken place, no correct opinion can be formed of the ultimate effect; sufficient, however, has been done to enable this point to be decided

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with tolerable accuracy, namely, that if the present plan be carried into effect to its fullest extent, the original object of making this harbour an effectual asylum for all classes of vessels detained by contrary winds, or taking shelter on account of stress of weather, will be completely obtained; but as the embarkation and disembarkation of passengers require accommodation of a different kind, namely, greater convenience and more tranquillity, the cost of which was never included in the original estimate, some additional work is necessary to obtain that desirable object.

With regard to the second—there are three places where the required accommodation for steam-packets may be obtained. either on the east or west pier, or towards the centre of the harbour, to the eastward of the present boat basin.

The east pier is rather too far out of the way from Dublin, and would interfere with the present Post Office station, although by widening the upper end, and running out an arm from it, a convenient landing-place might be made at a moderate expense, as the pier would form so much of the work. The west pier, unless the extremity, when finished, be adopted, would be rather exposed to the entrance, and has less depth of water, although it would interfere less with the general form of the harbour, and its greater proximity to Dublin would render it advantageous in some respects.

The middle of the harbour to the eastward of the present boat basin would be equally convenient, and there being sufficient depth of water near the shore, a pier of moderate dimensions would suffice, the roads and approaches being already made, and consequent saving to that extent would arise. It would be easily accessible to and from the sea during the prevailing winds; and it would be well protected by the eastern pier from the dangerous quarter, and the range of the sea during storms would be more limited. Under all these circumstances, the situation marked A, or thereabout, upon the accompanying plan, appears advisable for the general purpose of a landing-place.

The next point to be considered is, what kind of construction would be most likely to obtain the desired object? From the great depth and extent of water contained in the outer harbour, being nearly 240 acres, and from the frequent and violent storms which occur, there is reason to believe that without some work more enclosed than a bare quay wall there would scarcely be that tranquillity and security for the embarkation and disembarkation of passengers and carriages that it is so desirable, and almost indispensable, for a Packet Station; for this reason I would recommend that the pier should have a returning arm, in order to prevent the inrun of the sea; it should also be provided with landing-slips and stairs, for carriages and horses on both sides, and every requisite for extensive accommodation.

The expense of this work will amount to the sum of 35,360*l.* If the landing place was to be made on the east pier, it would only cost 24,140*l.*; but then the accommodation would not be so good.

With regard to the propriety of uniting the Station for the Post Office packets with those of the public, it may be observed, that the services are of such a dissimilar nature, that I think they would be better by being kept separate, and when the outer piers are finished, a very convenient station might be found for the former within the jetties and pier heads, where a certain portion of both heads will require retaining walls of masonry, at all events; and as the Post Office are already provided with temporary accommodation for their packets, so far as they are concerned, it may be deferred until the harbour is finished, if, however, it should be found preferable to have the packets nearer to the shore, a small jetty might be run out from the east pier for their accommodation.

I have, &c.,
JOHN RENNIE.

The Commissioners of the Royal Harbour of George the Fourth,
&c. &c. &c.

No. 20.

No. 20.
Warren's Report on the Harbour.

Capt. WARREN'S *Report on the state of the Works at Kingstown Harbour.*

Dublin, 19*th July*, 1831.

The east pier head having suffered much from the gales in the winter, in consequence of the coping not having reached that length, I consider the first object would be to repair it without loss of time, and before the bad weather sets in.

The next object I would recommend is a wharf, to be constructed of stone, on the south side, as shown on the plan, which would have 20 feet at it at low water, for the use of steam packets, there being at present but one built of wood, by order of the Post Office Department, and which is in a very dilapidated state. There is already a quantity of stone prepared for this purpose, and if it was made to extend to 400 feet, merchant vessels could take out their cargoes at it, which would be an inducement to forward the proposed railroad between the harbour and Dublin and be a great saving to the trade, as vessels that draw too much water for the Dublin bar are in the habit of having their cargoes taken out and carried round at a great expense, and when lightened sufficiently, pay a considerable sum to be towed there by steam vessels; this measure will be likely to create a revenue for future improvements.

There are various opinions as to the plan that would most likely prevent the swell which sets into the harbour with an easterly wind. I consider that anything carried *across* the set of the tide would cause an eddy, and be likely to form a bar at the entrance. The most effectual plan would be an outer breakwater, placed at the distance of about two cables' length from the pier heads in the direction of the tides, but this could only be done at a very considerable expense. If the east pier head was carried on for half a cable's length, a little inclining to the west as shown on the plan, I think it would have, in a great messure, the desired effect, but would cost, according to the estimate of the engineer, not less than 50,000*l.*, including a permanent finish of cut stone.

Whether the pier head is projected in the way I have mentioned, or remains as it is, vessels making for the harbour with a wind that prevents their fetching in to an anchorage, can anchor a little short of it, that when they bring up they would have the harbour open. If a buoy were placed just within the lighthouse, as shown in the plan, a hawser run to this would swing them in without difficulty. It would also be desirable to have a buoy placed in a similar situation at the west pier head.

SAM. WARREN, *Captain R.N.*

N.B. The southern corner of the harbour appears well adapted for Morton's patent railway slip for heaving up vessels for repairs.

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Admiralty Minute.

Admiralty, 26th July, 1831.

ACQUAINT the Treasury, that in transmitting this report of Captain Warren, with certain other documents relative to the works in progress at Kingstown Harbour, their Lordships recommend the completion of the sewer, the casing of the piers with masonry, the immediate repairs of the extremity of the eastern pier, so as before winter to protect it against further damage. and the building of the wharf at the point marked out on the plan enclosed, adopting the advice of Captain Warren, that it shall be 400 feet in length, and extended outwards into 20 feet depth at low water.

Their Lordships cannot recommend the extension of the eastern pier at an outlay of 50,000*l.* The eastern side of the harbour is now completely sheltered without this extension, and affords ample accommodation for the present trade frequenting it; at any future time this addition may be made, if considered prudent and found necessary; but the advantage of greater protection within the harbour must always be weighed against the certain evil of narrowing the entrance, and increasing the difficulties of ships in distress fetching into the anchorage.

J. G.

No. 21.

Lieut. HUTCHISON's *Objections to Works in progress at Harbour.*

No. 21.
Hutchison's objections to Harbour Works.

MY LORD, *London, May,* 1833.

I most respectfully beg to address you on a subject, which I consider of the first importance to the mercantile and shipping interest of Dublin, and the trade in general of the Irish Channel.

From my holding the appointment of Harbour Master to the Asylum Harbour, at Kingstown, since January, 1823, an opportunity has been afforded me from continual observation and experience, of forming a pretty accurate opinion as to the manner in which the entrance of that harbour should be finished; it is, therefore, with infinite regret I understand, that a projection of 360 feet on the south pier, in a parallel line to the west pier, has been determined on and commenced, and to which I now humbly beg leave to state my objections. In the first instance, it will make it extremely difficult for large vessels to enter the harbour during S.W. gales; secondly, for wind bound vessels to put to sea with north and N.E. winds; and, thirdly, a decrease of near two feet depth of water at the point of the south pier; and ultimately, the contraction of the mouth to a totally inadequate space, by the positive necessity of a turn on the west pier; as by the proposed extension, the easterly sea will be inevitably directed even more than at present into the N.W side of the harbour.

In my opinion, there is but one way to form the entrance, which will not be liable to objection, and I would most urgently advise that the eastern pier should cease at its present extent, forming a circular abutment of cut stone to erect a light-house; the west pier to receive a turn of 300, 400 feet in a S. by E. direction, which is essentially necessary to exclude the sea or swell, which rushes along the inside of the north pier, and causes such uneasiness to the shipping in the old harbour during easterly gales, and prevents wind bound vessels anchoring at the north side, their proper berth, and from which they could proceed on change of wind with much greater facility than at present, and that difficulty will be increased if the present intention in progress be carried into effect. Trusting these observations, which I have deemed it my duty as a naval officer to suggest ere it be too late for your Lordships' consideration, I am emboldened to hope the importance of the subject will be a sufficient apology for this intrusion.

I remain, &c.,
WM. HUTCHISON, Lieut. R N., *Harbour Master.*

To Sir James Graham, Bart., &c. &c.,

N.B.—In consequence of this representation, I was ordered to attend at the Admiralty, before Sir James Graham, Sir Thomas Hardy, Sir John Burgoyne, Sir John Rennie, Admiral Warren, and Captain Beaufort; and having stated my opinion, I believe to the satisfaction of these gentlemen, the Commissioners of Kingstown Harbour were directed to stop the advance of the east pier, having then carried it out about 80 feet of the intended 360.

No. 22.

Report on the Royal Harbour of Geo. IV., at Kingstown, Dublin, by W. CUBITT, C. E.

No. 22.
Cubitt on completing the Harbour.

SIR, 16, *Parliament-street, London,* 21*st March,* 1835.

In pursuance of instructions with which I was favoured on the 20th ult., I proceeded to Kingstown immediately after the 2nd instant, for the purpose of inspecting the Royal Harbour of Geo. IV., at that place, with a view to forming a plan for its final completion.

In making my investigations and inquiries, I received every facility for the purpose from the Commisioners of the Harbour, and every assistance that could be rendered by Mr. Thomas, the resident engineer, and Lieut. Hutchison, R.N., the harbour master, for which, together with free access to all papers and plans on the subject, in the office of the Board of Works in Dublin, and Harbour Office in Kingstown, my acknowledgments are due to Colonel Burgoyne, his coadjutors, and officers respectively.

Having made the requisite inspection of the harbour, I returned to London again on the 15th, since which time I have been engaged in the investigation of the subject, and forming plans and estimates for the final completion of this great undertaking, and have now the honour of submitting to your notice, for the information of the Lords Commissioners of the Admiralty, the following report on the subject, together with the accompanying plans therein referred to, which I trust will prove satisfactory, and of which I shall be most happy to hand any further explanation.

I have, &c.,
W. CUBITT.

To the Right Hon. G. R. Dawson.

THIS harbour, the general form and situation of which will be seen on referring to a chart of Dublin Bay, is formed by means of two extensive piers or breakwaters of rough stone, projected into the sea so as to inclose between them about 240 acres of water, varying in depth from 15 to 26 feet at low water of spring tides.

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The piers being now brought to a distance of less than 1,000 feet of each other, it became a matter of the very first importance to determine in what manner the entrance of the harbour shall be completed, so as to combine the grand requisites of a safe and quiet harbour with those of the greatest possible facilities of ingress and egress for vessels under all circumstances of winds and tides.

Many and various are the plans which have been proposed for this entrance, both by naval gentlemen and engineers, but they almost all resolve themselves into the single principle of contracting the entrance by an addition, in some particular direction, to the end of one or both piers.

Now there is no doubt but, by contracting the entrance, the harbour may be rendered more quiet in almost any wind; but in proportion as the entrance is narrowed, so will the difficulty of entering it be increased in adverse gales of wind, when the harbour, as an asylum, is most needed; or the the difficulties of departure increased, when the wind shall become fair for vessels sailing. and it is my decided opinion, that if the entrance be made much narrower than it is at present, it will be too narrow to be entered, with facility or safety, under difficult cases of adverse gales of wind; but, if left of its present width, without something being done to keep out the heavy range of the sea, which rolls in with the wind anywhere to the southward of Howth Head, more than half the harbour will be so much exposed as to render it unsafe riding at anchor within it, and impossible to lie at a wharf at any part in gales of wind, from the N.E. to the S.S.E. inclusive.

Under these circumstances, I am led to the conclusion that nothing will meet all the difficulties of the case so well as covering or protecting the present entrance by means of a detached pier or breakwater, and finishing the harbour piers with good bold circular cut stone-heads, 300 feet in diameter, and 900 feet apart, as shown on the general plan, and more particularly described in Appendix No. 1.

Covered in this manner, the harbour would be rendered (in my judgment) safe and quiet in all winds, particularly in those to which it is now the most exposed; and, at the same time, the means of ingress and egress would remain just as free and easy as at present, or even more so, with the advantage of covered anchorage at the back of the breakwater, in strong gales from the W. and W.S.W., in a good situation to make sail from on a change of wind or tide, to enter either of the harbours of Dublin or Kingstown.

This breakwater would be 1,200 feet long, 20 feet above high water, and with a paved slope or glacis of five horizontal to one perpendicular on the sea face, with a low distinguishing light at its eastern end.

Adverting again to my instructions, in which I am desired to examine into the whole "question, and to report as to the best mode of completing this great undertaking," I take it for granted that not only the completion of the entrances, but also what may be termed the "necessary appendages" to the harbour, when so completed, should also come under my consideration.

With this view of the case, I have examined into the subject, not as an asylum harbour merely, where vessels could enter in stress of weather, and remain in safety, but also as a naval and packet station, and, in some degree, also, as applicable to the mercantile marine; for, by the aid of the new wharf, and the Dublin and Kingstown Railway, foreign vessels, and East or West Indiamen, might be enabled to discharge their cargoes, instead of waiting too long a time for wind or water to get into the River Liffey.

I, therefore, deemed it essential in this harbour that there should be, first, a graving dock, capable of receiving and refitting one of His Majesty's largest class steamers or frigates. Second. A patent slip, ready for hauling up, examining, and repairing all the smaller class of vessels under 300 tons, that may come into the harbour, with damage, or want of repairs, on the instant. Third Wharfs, viz., one good wharf at least on each of the piers, and one at the upper end of the harbour, as shown on the plan.

Now, the first of these objects (the graving dock) has not been lost sight of by Mr. Thomas, the present able resident engineer, who had proposed a plan for that purpose, which I have inserted in the plan accompanying this report; and a wharf at the upper end of the harbour has been for some time in progress, under the directions of the present commissioners, to the extent of 400 feet in length, 130 feet of which is up and ready for use, and the remainder will probably be completed this summer. Mr. Thomas's plan is to extend and combine this wharf with a graving dock, as shown in the plan, which, if means can be found in course of time to effect it, will render the harbour very complete for naval purposes. An excellent situation for a patent slip exists at the southern angle of the harbour. The wharfs I would recommend on the piers are, a stone wharf 300 feet long, parallel to the eastern pier, in the place of the present Post-office wooden wharf, at which three packets or vessels could lie alongside; and a pier, projecting at right angles from the western pier, 250 feet long, and 100 feet wide, at which two vessels could lie at each side, and one at the end. This pier would not only possess, at all times, the advantages of a lee side for vessels to lie at, but, at the same time, serve as a protection to the old harbour of Dunleary, and the merchant-vessels lying within it.

The works above enumerated constitute all that I think requisite (over and above what is at present in hand) for the completion of Kingstown Harbour, and are all tinged red on the plan to distinguish them as new works; and the probable expense of all which, would not, in my estimation, after the most careful inquiry and examination on the spot, exceed the sum of 275,000*l.*, of which I estimate

	£
The completion of the pier-heads at	110,000
The external breakwater at	75,000
The graving dock, wharf, patent slip, &c., at	50,000
The new east and west wharfs, at	30,000
The completion of the present wharf, rough coping, and finishing off piers, &c., and finishing works in hand, at	10,000
	£275,000

reckoning all the present stock of stone in hand to stand against extraordinary contingencies, over and above the contingencies included in the above estimates.

In carrying these works into effect, I would suggest that the works in hand (viz., the 400 feet wharf, and the finishing up the roads, slopes, &c., to piers) be completed forthwith; and that preparations be made, at the same time, for completing the entrance, of which the eastern pier-head should be the first work set about, and then the western, after the breakwater should be commenced; or should it be thought desirable to give the harbour a few seasons' trial with the finished heads, the

No. 22.
Cubitt on completing the Harbour

interior appendages of the harbour could be proceeded with in the interim; because, if used, either with or without a breakwater, I deem the pier-heads, as proposed on the plan, the most suitable for the purpose. (*See* Note).

I would also urge, most respectfully, that much will be saved by coming to an early determination on this important subject, whatever or whatsoever plan for the purpose may be chosen to carry into effect, inasmuch as a great deal of capital lies waste in material and apparatus, and an establishment necessarily kept up for doing but little, which could effect a great deal, if arrangements were made accordingly, and means provided to set them to work.

To complete the works now in hand, and make preparations for, and get fairly entered upon, the foundations of the east pier-head would occupy the present year; in doing which, a sum of from 25,000*l.* to 30,000*l.*, or even more, might be disposed of advantageously; and when the works are brought into full and steady operation, it would require from 40,000*l.* to 50,000*l.* per annum to carry them on to completion, with the greatest degree of economy, and take about six years from this time to complete finally, at that rate of proceeding.

W. CUBITT.

NOTE.—The pier-heads recommended in the foregoing report are proposed to be circular heads or towers, with walls of solid masonry at least 12 feet in thickness, brought up from the bottom by means of the diving-bell.

The diameter of the heads will be 300 feet, which will not only afford a good return pier to protect the inside of the main piers from the range of oblique seas entering the harbour, but afford ample space in the circular platforms within the parapets for the purposes of stone-houses, boat-houses, pilots' dwellings, or even batteries, for the means of defence, if necessary, and for which they are, from size and form, well adapted. A plain plan and section of one pier-head, with the dimensions written in, is shown on the following page.

W. C.

No. 23.

Lieut. HUTCHISON, R.N., *on the Damage caused by the E.S.E. Gale of the 16th March*, 1844.

No. 23.
Hutchison on Damage caused by Gale of 16th March, 1844.

SIR,

Kingstown, 18*th March*, 1844.

I beg to report, for the information of the Commissioners of Kingstown Harbour, the casualties which occurred in the violent gale at E.S.E. on Saturday last. During the high water at 9·30 A.M., all the vessels anchored in the harbour held on, and it blew as strong as during the low water at 3 P.M., when, one after another, they parted or slipped their cables, as they came in collision with each other. The brigs "Hemer," "Tom," and "Mary," the schooners "Betties" and "Agnes" drove on the rocks near the ship-yard; as the tide rose, two of those were forced into the old harbour, five more ran in there when they parted from their anchors. All the hawsers I had were furnished to them, but three times the number would not suffice to secure them, the rolling swell was so great. No vessel of any great value has suffered; they are loaded or light colliers, which, from the little profit in their trade, are badly found, and their chain-cables manufactured of the worst iron. This, with the exposed anchorage they were in, is the cause of their not riding out the gale, which those in the sheltered part of the harbour did, without one exception. The gale was sudden, and caught several of those vessels in exposed situations, whereas those driven in from sea on Saturday anchored in safety.

The crews of the wrecked vessels, as the tide rose, were in great danger, and, having no life-boat, I was obliged to offer 10s. a-man to two yawls to bring the crews on shore, and I beg to forward the certificates from the masters of the vessels.

I have, &c.,
WM. HUTCHISON.

To Henry R. Paine, Esq.,
&c. &c.

DEAR SIR,

25*th March*, 1844.

I regret to inform you the report in the newspapers is too true of the most violent gale from E. by N. to E.S.E., on the 16th, that we have had since 1826, and the damage done to the shipping in the old harbour, and those that run there, has been very great, as it was low water when they parted in Kingstown Harbour, and the light vessels beat against the loaded until they could be secured.

These vessels were all anchored to the northward of a line drawn from east pier-head to the Anglesea Arms Hotel, and at low water, when the gale was at its height, snapped their chains; three brigs and two schooners drove on the rocks at the ship yard; five more run to old harbour. No vessel drove or parted that had the shelter of the East Pier; but the heavy ground swell and sea which entered the harbour on the north side, made it a dangerous roadstead; and I can designate the old harbour to nothing else, when the tide was in, than a tub of water set in motion. The piers have not sustained any injury; the west pier-head, which had been strongly piled preparator ytu facing with cut-stone, received some injury; the piles stood, but the camel erected on it was thrown down, a quantity of the stonework on the outside face drawn away. The sea in the bay appeared to the "Dottrel," who went out, like one vast sand bank, until the vessel weathered the "Light Ship," who fortunately did not break adrift until the morning of the 17th, and another was in her place the following day at two o'clock.

It is not too late to put an elbow of 200 or 300 feet on the north pier, the only way to make that side of the harbour smooth and secure; it ought to be done before any more work proceeds. This would protect the old harbour, and make a projection, or tongue, somewhere on the inside of the pier, to stop the course of the sea as it rolled towards its entrance, unnecessary. There was a great error committed in ever facing the inside of walls of both piers: the ragged and rough wall cut up the swell, which the smooth face permits to roll in easterly gales, and with north gales causes such agitation on the south side, the sea being pent up.

I am, &c.,
WILLIAM HUTCHISON.

To Captain Beaufort, R.N.,
&c. &c.

Appendix B.

Kingstown.

No. 24.
Gibbons on Damage caused by Gale of 1st Nov. 1844.

No. 24.

Mr. Barry Gibbons *on the Damage caused by the E.S.E. Gale of the* 1*st and* 2*nd Nov.*, 1844.

Sir,
Kingstown Harbour, 4th Nov., 1844.

I beg leave to submit to the Commissioners the following statement of the effects on the works here of the late storms, which, for extreme violence and duration, have rarely, if ever, been equalled since the harbour was commenced.

I am happy to say, that the piling and timber framing, and all the stone work connected therewith, at the West pier-head, have effectually stood this severe trial, although the sea broke most tremendously over it. There has been little or no injury done, and there will be no interruption to the progress of the work as soon as the weather moderates. A large portion of the rubble slope north of the framing has, however, been drawn down, and, in order to secure the temporary light-house, and prevent any further extension of this travelling, it will be necessary to face it with a rubble wall for its protection till the work of the circular head has progressed sufficiently to enable us to commence the sea-pavement.

At the east pier-head the *rough dressed* pavement immediately adjoining the circular head has not been in the least disturbed, except at the raking of the work, where the last two courses, as may be expected, have been displaced; but I regret to say, that the whole of the rough pavement which we have been setting during the last three months has been carried away. This has been chiefly occasioned by its not being connected with the other parts, which there was not time to effect; and when a mass of rubble which protected this was swept away, the rake of the work became exposed. The amount of the damage done is about 140*l*., besides the loss to the contractors of their two cranes. Along the eastern pier, the rough mound of rubble placed there to strengthen the toe of the slope, has, in a few places, been carried out and down to the plane of the sea-pavement, and directly opposite where this occurs the temporary rough parapet is thrown down, and a small breach made; the tramway on the top of the level has been disturbed in several places, and the footpath along the pier torn up by the fall of the sea, and the small rubble scattered over the surface. I expect to have these damages put to rights again at no very material expense. There has been no additional breach of any importance made in the sea-pavement along the pier, as far as I could examine, with the rough sea and neap tides now.

I have, &c.,
Barry D. Gibbons.

To Henry R. Paine, Esq.,
&c. &c.

No. 25.
Hutchison on Damage caused by Gale on 1st Nov., 1844.

No. 25.

Two Reports by Lieut. Hutchison, R.N., *on the E.S.E. Gales of the* 1*st and* 2*nd Nov.*, 1844.

Sir,
Kingstown, 4th Nov., 1844.

I beg leave to report, for the information of the Commissioners of Kingstown Harbour, the casualties during the gale of the 1st and 2nd instant.

In consequence of strong winds from the south, many coasting vessels had collected by stress of weather on the western side of the port; but on the afternoon of the 1st the wind veered to the E.S.E., and blew a whole gale; two large ships and several brigs were driven in on this day by the gale. On the 2nd, before day-light, the barque "Kingston," of 282 tons, from Liverpool to Africa—cargo salt and casks—and the schooner "Commerce," of 51 tons, coal laden, parted their chain-cables and stranded in the entrance of Old Harbour. At 8 a.m. the brig "William and Isabella," of 189 tons, from Archangel to Gloucester—cargo plank—parted and drifted in, and across the bows of the barque several small vessels run in, and got round into shelter of Old Pier by their light draught of water.

I had early in the morning employed drays to bring round the hawsers from the Boat Harbour stores, but was retarded much in my anxious desire to render prompt assistance, by the unreasonable demands of the boatmen; after much persuasion and promise of liberal compensation, two crews launched their yawls to bring lines from the stranded vessels, by which large hawsers were hauled on board them; meeting the second mate of the "Kite," revenue-cutter, I requested him to come down with a party of seamen and boat to aid me. Much praise is due to this officer for his ready and truly seamanlike and exemplary activity on such an occasion: the vessels being aground, more could not be done than to heave the brig clear of the barque, to prevent their beating themselves to pieces, and if possible, as the tide rose, to draw them over to the Old Pier-head; but the large hawsers to brig and schooner were carried away. The "Kingston" was secured by hawsers, head to the sea, the position proper to preserve the ship, when unfortunately another brig, "Capricorn," of 240 tons, from St. Domingo to Liverpool—cargo mahogany—drove in on her. I had left the mate of the revenue brig "Shamrock" an hour previous in the outer harbour, to secure and make this vessel snug, but she parted her chains in consequence of her top weight. I ordered her masts to be cut away, to ease her rolling and grinding against the inner vessel. Their draught of water made it impossible to disengage them, even if more hawsers were available. After dark, the schooner "Hercules" run in and sunk against the West Quay. At 11 p.m. I was called up by the coast-guard, the barque "Kingston" being on fire; the fire-buckets were taken down by men on watch, but as no attempt was made to extinguish the fire on its first appearance by either coast-guard, and police, in charge of her, from the report of a large quantity of gunpowder being on board, by the time I got down and the master was found, the flames had extended from the mainmast to the stern, and too late to prevent her destruction. He informed us there was only two kegs of 25 lbs. each. My opinion as to the cause o the fire is, that persons were tapping some rum on board; the whole crew had left her, with their chests and bedding, by 6 p.m., and no fire had been lit on board during the day, and the blaze issued from the spot where the casks of rum were stowed. There were at anchor in the harbour 1 ship, 2 barques, 9 brigs, 33 schooners, 9 sloops, and 18 trawlers, 1 war steamer and a surveying steamer, a revenue brig and cutter.

The holding ground is certainly good, from the chains giving up and not the anchors drawing. There was a heavy swell in the harbour where the merchant-vessel lay, and more sea broke over the east pier than I have seen for many gales.

I have, &c.,
Wm. Hutchison, *Harbour Master, Lieut. R.N.*

To Henry R. Paine, Esq.,
&c. &c.

APPENDIX B.

KINGSTOWN.

No. 25.
Hutchison on the Damage caused by Gale on 1st Nov., 1844.

SIR,

Kingstown, 14th November, 1844.

I beg leave to answer the interrogatories of the Commissioners in as explicit a manner as in my power:—

First—The number and class of vessels in the harbour when the gale came on?

There was in the harbour on the morning of the 1st inst., before the gale assumed the violence it did that evening, and on the 2nd inst., the following vessels:—the "Stromboli" war steamer, "Lucifer," surveying steamer, "Shamrock," "Kite," and "Racer," revenue cruisers, 2 brigs, 27 schooners, 12 sloops, and a number of trawlers.

Second—The order in which the vessels that subsequently arrived came in, and what happened to each?

On the 1st inst. P.M., put in by stress of weather, one ship, one barque, one brig, five schooners, and two sloops. On the 2nd inst., one ship, six brigs, and one schooner, of which one barque and two brigs parted their chains, and drove against the west pier, and were lifted by the sea and carried along until they took the ground in the entrance of the old harbour.

Third—Of the vessels which went ashore or were injured, whether the accident in each case was inevitable, arising from certain disadvantages of the harbour, or entirely or partly from want of proper anchors and cables, or mismanagement, or want of sufficient crew or means on board, considering these not with reference to the equipment of a man-of-war, but what is usually to be expected in a merchantman of this class?

The barque "Kingston," of 282 tons, from Liverpool to Africa, with cargo of salt and casks, drawing 13 feet water, parted before daylight on the 2nd inst., had top-gallant masts up, the master states he had 75 fathoms of chain on one anchor; and 50 on the other; she was anchored too far to leeward, and not in shelter of the east pier; her sails were clewed up as she came round the pier head, she could not therefore reach a weatherly berth; this vessel was well found and manned.

The brig "William and Isabella," from Archangel to Gloucester, with cargo of deals, drawing 12 feet, parted early on the morning of the 2nd inst., and drifted in and across the bows of the barque; her top gallant yards were aloft; had a very inactive master and crew; was well found.

The brig "Capricorn," of 240 tons, from St. Domingo to Liverpool, with cargo of mahogany, drawing 15 feet, arrived from sea at 2 P.M. on the 2nd inst., in the worst of the gale, and clewed up her sails too soon; I hastened to her assistance, and also a boat from the "Shamrock;" she brought up with two anchors, but shortly after drove, in consequence of the stock of one of them having broke; she then again held on, and about 4 P.M. parted her chain. I had directed the mate of the "Shamrock" to strike her yards and masts, and then hastened to other duty. She drove on shore with top-gallant masts up; her crew were one-half disabled from fever and fatigue on the home voyage.

The schooner "Hercules," of 84 tons, coal laden, parted chains and run in and bilged against the west quay at 6 P.M.

The schooner "Commerce," of 50 tons, coal laden, parted chains and run in, grounded and bilged about 8 A.M.

Several small schooners and sloops either slipped or parted, and run in the morning for the shelter of the old quay; from their light draft of water they succeeded in securing to the quay, but the swell caused all the colliers and them to receive much injury from beating on the ground and against each other; one sloop laden with oats sunk.

The origin of these wrecks is to be ascribed to several causes,—the unsheltered anchorage of one half of this harbour, open to easterly winds and swell, the liability of chain cables to snap in a rough sea or swell, if not manufactured of the very best iron, as they were by the patentees in the first instance: they are now a general manufacture, and no dependence can be placed in them, for many are not much better than cast iron; the same applies to anchors, which repeatedly break in this harbour in gales of wind; and, lastly, to the utter indifference and aversion masters and crews of merchant-vessels have to strike masts and yards, the vessel being insured; nothing, I do believe, but fear of loss of life, will make them reduce top weight, or cut away the masts, when either one or the other course would preserve hundreds of vessels from a lee-shore by easing the strain on their ground tacklings.

Fourth—Whether any loss of life occurred, or what injuries were sustained by the men on board, or those giving aid?

No loss of life occurred during the gale; the mate of "Kingston" had his hand crushed by the falling of "Capricorn's" mast.

Fifth—Which of the vessels have been entirely lost, or must be broken up? and which it is likely may be repaired, and generally what cargoes are lost or damaged?

The "Kingston," having taken fire on the night she was stranded, is the most injured—almost a total wreck; she will be sold as she now lies for the benefit of the underwriters; her cargo salt and casks, the former destroyed.

The brigs "William and Isabella" and "Capricorn" were dismasted, and much battered; the first has been, and the other will be, floated to Dublin for repair.

The schooners "Commerce" and "Hercules," on the removal of cargoes, will be repaired; they are not insured.

Sixth—How Mr. Hutchison and his men were engaged? and what harbour? means of hawsers or stores were employed? and what has been the consumption of them?

During the 1st inst., myself and boat's crew were employed berthing the vessels as they arrived, and directing them to make their vessels secure. At daylight on the 2nd I was called to the Old Harbour to the wrecks; I immediately procured drays, and was backwards and forwards hastening my men to load the hawsers; as they arrived they were run out by the yawls I had hired; my boat, if brought down, would have swamped. A six-inch was run to the sloop "Busy," of 47 tons, laden with grain, and beating against the west quay: she was preserved from sinking, and got over to the coal quay. A seven-inch was run out to the brig "William and Isabella," on board which vessel I went myself with my men; she was across the bows of a barque, grinding and surging with every sea; she was hove clear, but being a-ground, could not be got (until the tide should rise) over to the Old Pier; her masts went by the board, her bowsprit having been carried away against the wall; by this time the "Kite's" men had come; with their assistance the large nine-inch hawser was got on board the barque from Pier Head, and her side hove clear of wall, and secured with another hawser. At the time all this was effected it was one o'clock, when myself and crew went to breakfast, and to put on dry clothes. At two P.M. I went out in my boat to assist the brig "Capricorn," the sea and wind then raging in the harbour, could barely be stemmed, and on our return to the shore the water was over our ancles; I then again went to Old Harbour, it being high water, and found that the

APPENDIX B.

KINGSTOWN.

No. 25.
Hutchison on the Damage caused by Gale on 1st Nov., 1844.

hawser to "William and Isabella" had broke, and she had drifted towards the west quay, and the end of same had also broke from the schooner "Commerce:" the rope was a good one, but when vessels are on the ground, the rolling motion caused by swells stretches the rope, and if she does not draw a-head it will burst. I had no other hawsers to run to these vessels. At this time the "Kingston" was comparatively safe, when the brig "Capricorn," between three and four, drifted in and on board her. I bailed the brig to cut away her masts to arrest her drifting along the wall, but there was no person at all active on board; and when they were cut away, she had come in collision with the "Kingston," rendering all further efforts to save either fruitless. When informed of fire on board the barque, 11 P.M., I attended with fire-buckets, and those of my men I could get; but the report of gunpowder being on board prevented any exertion, and the police would not allow any man to go on board.

All hawsers used are much injured, and rendered useless for harbour purposes.

Seventh—What boats and men he engaged extra, and on what terms?

I had two yawls and crews to get the hawsers on board, the crews of the vessels gave but little assistance when wrecked; and as a few active seamen are of great value at such a time, I requested the mate of the "Kite," cutter, to come down to carry into effect my directions.

The terms demanded were half-a-guinea per man, and I agreed with them for seven-and-sixpence each.

I have, &c.,
WM. HUTCHISON, *Harbour Master, Lieut. R.N.*

To Henry R. Paine, Esq.,
&c. &c.

No. 26.
Hutchison on the Want of additional Shelter.

No. 26.

Lieut. HUTCHISON, R. N., *on the Necessity of additional Means of Shelter for Shipping.*

SIR,

Kingstown, 14*th November*, 1844.

In reply to the second part of the Commissioners' letter of the 6th inst., as to any additional means that could be provided that might tend to lessen the injuries which occur to shipping in the harbour during occasional gales from the east, excluding for the present any proposition for additional jetties or breakwaters:—

First—Whether the harbour boats are in number and quantity sufficient, assuming that Mr. Hutchison has authority to hire in cases of emergency whatever he may require?

The most important prevention to wrecks during gales from the east, when driven by stress of weather to bear up for Kingstown, in my opinion, is the invaluable assistance of a sensible pilot, to keep sail on the vessel to bring her to an inside and sheltered berth. The pilot cutters do remain out in the bay at times when there is imminent risk in boarding, and if a proper encouragement were given, would be more on the alert during easterly gales; but, as they are only entitled to the smallest rate (1*s.* per foot only) for boarding vessels in the bay, in fine weather as in a storm, it is not surprising they come in when they are most required. I would, therefore, beg to suggest that the most active of these men should be hired at pilots' wages, 5*s.* per day, to assist me to meet the vessels at Pier Head as they round it, and assist to clew up sails and bring them to an anchor in proper situations, and to veer the requisite scope of cable. Another six-oared boat would be required for this special purpose.

Second—Whether any moorings could be laid down usefully on the west side of the harbour, or in front of the entrance of Old Harbour, which vessels driving, or having parted, would have a possibility of catching, and which at the time would present no inconvenience to the anchorage or entrance at other times?

In the instance of the late convict hulk, "Essex," formerly moored in the angle of the east pier, by 140 fathoms of heavy long-linked chain, I have known many vessels, driving with their anchors, to have been preserved from going against the pier by the anchor hooking the chain. On the same principle a chain stretched across from north to south, at a proper distance from the entrance of Old Harbour, would, if the vessel's cables had not parted, give her a fair chance of preservation from going ashore; but then it is to be considered, that if the vessel is of large draught of water, she would strike with heavy swell at low water, and become leaky. Her sinking in such a situation, and removal to the very beach she would have drifted on, would cause a great outlay, as well as the destruction of her cargo. If moorings were placed further out in the harbour, vessels would hook them continually. Of the two, I should prefer the extended chain, as it would present no inconvenience.

Third—Whether any additional anchors, cables, hawsers, or other disposable stores would be desirable, or capsterns, mooring posts, &c.?

From the frequency of large vessels being stranded, and smaller vessels driven in during easterly gales, at the Old Harbour, there is a demand for the use of hawsers, chains, and fenders, and a capstern on Pier Head. I consider a store should be built on the same spot for those articles, in which store 4 hawsers, 60 fathoms long; 6 pieces of chain, 30 fathoms long, of different sizes, to secure vessels, and 12 elm fenders and capstern bars would be kept; also three or four stout posts on the West Pier, with pieces of chain, to arrest a vessel until hawsers and anchors could be brought to heave them from the wall, would, on occasions, be found most useful. These articles would last many years with care, and safe from depredation.

Fourth—Whether good boats and men are always to be hired on such occasions without delay?

The fishing skiff or yawl answers the purpose very well of laying out a line to which the end of a hawser is attached and hauled on board; but in hiring the aid of the crews of these boats, you cannot select a crew, but must take the usual fishing crew attached to the boat, and they rate their services at half-a-guinea to a guinea a man, which, in some cases, where real good service is rendered, is not unreasonable; but, on other occasions, exorbitant. Their demand before launching boat is, "What are we to get?" and should effort to assist be fruitless, the sum is still rigidly exacted. These men are not seamen, and the extent of their assistance is running out a hawser and assisting to heave at the windlass. To furl sails, strike yards and masts, they are quite incompetent; and when real active exertion is necessary, one able seaman is worth a score of them. During the late gale these boatmen exacted great value for their exertions, as every small vessel which run in required a rope to be run to the pier. To my knowledge one yawl's crew made 2*l.* a-man on the 2nd inst. There were many employed in the same way.

Fifth—Whether the charges for hawsers and assistance are unreasonable or unusual, or, indeed, more than the actual cost for wear and tear?

No. 26.
Hutchison on the Want of additional Shelter.

The printed regulation of charges for use of hawsers, anchors, and assistance, are very moderate, and not more than sufficient to defray the wear and tear of same. No owner or master of a ship could expect the use of those things gratis, without they paid port charges; but I think a distinction should be made where they do, to Kingstown Harbour.

I take this opportunity of calling the attention of the Commissioners to the urgent necessity of accommodation for my boat's crew. Living, as I do, at the harbour, I am frequently called up at night to send assistance to vessels adrift or driving; before I can get a boat's crew together, the vessel might sink or be burned. The price per week of dirty cabins or lodgings, if to be obtained near the harbour, is exorbitant. It would require as many messengers to assemble six men in any reasonable time.

I am, &c.,
Henry R. Paine, Esq., WM. HUTCHISON, *Harbour Master, Lieut. R.N.*
&c. &c.

No. 27.

Correspondence relative to the Want of a Graving Dock in Dublin and Kingstown Harbours.

No. 27.
On the want of a Graving Dock at Dublin and Kingstown.

City of Dublin Steam Packet Company,
18th December, 1844.

GENTLEMEN,

Having understood that some other steam companies of this port contemplated soliciting your aid and support in favour of an application for the construction of a graving dock at Kingstown adequate to the receiving large steam ships, I am desired by the Board of Directors of this Company to express their anxious hope that such accommodation will be granted.

So thoroughly acquainted as you must be with the wants of the harbour in this respect, they deem it quite unnecessary to give instances of the inconvenience and injury sustained in this port from the circumstance of there being no suitable graving dock for steam vessels, either at Kingstown or in the Port of Dublin.

The Directors, therefore, respectfully urge on your Board the great importance and necessity of having this want supplied with the least possible delay.

I am, &c.,
To the Commissioners of Kingstown Harbour. P. HOWELL, *Secretary.*

SIR, *Office of Public Works, 20th December*, 1844.

I am directed by the Commissioners to acknowledge the receipt of your letter of the 18th inst., in which the City of Dublin Steam Packet Company express a hope that a graving dock will be constructed at Kingstown Harbour, to accommodate the shipping frequenting that harbour and the Port of Dublin, and to acquaint you that the Commissioners believe that there is much reason in the substance of the Company's representation, and will be most desirous of supporting their views, which, indeed, had been in some measure anticipated. M'Fagan rents a portion of the shore at Kingstown Harbour, on condition of constructing a large class patent slip on it. Difficulties having been pointed out in the way of completing that project, it is proposed to substitute a graving dock, towards which a considerable excavation has been already made, and which it is hoped the locality will admit of being carried out effectually.

I have, &c.,
P. Howell, Esq., HENRY R. PAINE, *Secretary.*
&c. &c.

Dublin, Glasgow, and Cork Steam Packet Company,
Dublin, 3rd January, 1845.

GENTLEMEN,

I am instructed by the Directors of the Dublin and Glasgow Steam Company to draw your attention to the want of a graving dock in the Port of Dublin, capable of accommodating steam vessels of large tonnage. We have, in consequence, frequently been obliged to send our vessels to other ports for repair; and at present our steam vessel, the "Vanguard," of 600 tons burthen, in want of repair from having got on shore off Cork, will require to be sent to Liverpool or Glasgow.

The Directors of this Company trust that, taking into consideration the large and increasing amount of steam tonnage owned in Dublin (probably equal in this respect to any port in the kingdom), you will use your best exertions to add to the benefits already conferred on the mercantile marine in the construction of Kingstown Harbour, by having a graving dock built in which steam vessels of large tonnage can be repaired, and thereby render Dublin independent of other ports, in a matter of so much consequence.

I am, &c.,
To the Commissioners of Kingstown Harbour. ANDREW TAYLOR, *Secretary.*

SIR, *Office of Public Works, 6th January*, 1845.

The Commissioners have received your letter of the 3rd inst., expressing the wish of the Directors of the Dublin and Glasgow Steam Company that the Board would take into consideration the necessity and expediency for constructing a graving dock to accommodate large vessels in Kingstown Harbour; and they have desired me to inform you, that they believe that there is much reason in the substance of the Company's representation, and will be most desirous of supporting their views, which, indeed, had been in some measure anticipated. Mr. Fagan rents a portion of the shore at Kingstown Harbour, on condition of constructing a large class patent slip on it. Difficulties having been pointed out in the way of completing that project, it is proposed to substitute a graving dock, towards which a considerable excavation has been already made, and which, it is hoped, the locality will admit of being carried out effectually.

I am, &c.,
Andrew Taylor, Esq., Office of Dublin and Glasgow Steam Packet Company. HENRY R. PAINE, *Secretary.*

No. 28.
Correspondence relative to Screw Moorings.

No. 28.

Correspondence relative to the necessity of Screw Moorings in Kingstown Harbour.

SIR, *Jupiter Steam Ship, Dublin, 9th January,* 1845.

I beg to enclose a Memorial to the Commissioners of Public Works, signed by the masters of steam vessels trading to this port, and which they trust you will lay before the Commissioners at your earliest convenience.

May I also take the liberty of remarking, that the steam company and ship owners generally agree on the subject of the Memorial, and will, if necessary, call the attention of the Commissioners to the unsafe state of Kingstown Harbour.

I am, &c.,
J. HIRSTE.

To the Commissioners of Public Works,
Dublin, 22nd November, 1844.

GENTLEMEN,

Much inconvenience and loss having occurred, at various times, to vessels frequenting Kingstown Harbour, occasioned by their anchors hooking the moorings which are at present laid down there, of which numerous instances can be adduced, in most cases attended with loss of anchors, we, the undersigned, respectfully beg leave to suggest that these should be removed, and the patent screw moorings substituted, the efficacy of which has been already fully tested in other ports.

Under judicious arrangements, there are few places where such could be made more serviceable than in Kingstown Harbour: the number of which ships anchoring there have greatly broken the ground, and rendered it not so good for holding as formerly, which the recent disasters there fully proves, some of which might possibly have been averted had buoys with this description of mooring been within the vessels' reach.

We are, &c.,
HENRY H. MILLS, *Duke of Cornwall.*
J. HIRSTE, *Jupiter Steamer.*
MICHAEL M'KINNON, *Vanguard Steam Ship.*
WILLIAM STOKES, *Eagle Steam Packet.*
JOHN HYDE, *Shamrock Steam Packet.*
JOHN JONES, *Duke of Kent Steam Packet.*
ISAAC DAVIES, *Ballinasloe Steamer.*
JAMES R. CHRISTIE, Commander of the *Birmingham.*
ROBERT KEMPSTER, *Shannon Steam Ship.*
W. SWAINSON, *Royal William.*
A. CHURCH, *Queen Victoria.*
WILLIAM WILLIAMS, Master of the *Duke of Cambridge.*
W. M'GRALTO, Master of the *Britannia Steamer.*
ROBERT WILLIAMS, Master of the *Nottingham.*
WILLIAM LANE TOOKER, Master of the *Ship Indian Queen.*
ARTHUR H. KEMP, Master of the *Brigantine Emma.*

Hutchison on Screw Moorings.

SIR, *Kingstown, 17th January,* 1845.

I beg to report on the statement of the commanders of the Dublin steamers and other vessels, and although I respect the opinions of such experienced seamen, I regret to differ, and cannot coincide in all they recommend.

First.—The inconvenience of the present moorings in hooking anchors is very often the case, but I have never known an anchor to be lost, as stated; on application they are always recovered, the parties paying the regulated price for clearing same.

That those moorings occupy part of the best anchorage of the harbour is the fact; and if the outer line, or revenue moorings, were placed from the southernmost packet buoy, in a line to the east pier head, they might be found useful to merchant vessels in gales of wind; anchors would hook the chains, but that I consider an advantage, and the buoys might be occasionally struck by steamers in dark nights. The Frigates' Moorings, which is a large chain extending 140 fathoms, might be laid down in a north-eastern and south-western line to intercept vessels driving with east and south-east gales, towards the old harbour, and three large buoys should be secured by a large chain, at 30 fathoms apart, to secure a driving vessel at.

Second.—Mitchell's Patent Screw Mooring has been tested in this harbour, and one of two has broken, by very moderate strain, at the shank, leaving the screw in the bottom; and even supposing them to stand a jerking strain, and a number of them laid down, I do think it would be no easy matter to secure ships to them, when adrift, in such a disturbed sea as is presented in this harbour, in two-thirds of its space, with a violent easterly gale; but I do not say, they would not be useful on solitary occasions.

Third.—The free anchorage afforded at Kingstown brings more vessels into it than need enter; vessels from Belfast, Glasgow, and Liverpool, that put in wind-bound, should pay a small charge to keep up two good boats and crews to assist them in and out; and half the vessels that anchor here to wait tide a few hours, should also pay, for they could on most occasions anchor or lay to in the bay. The bottom will be injured by the unnecessary influx of vessels. At present, the holding ground is good, and vessels more frequently part their chains than drive with their anchors.

I am, &c.,
Henry R. Paine, Esq., WILLIAM HUTCHISON, *Harbour Master, R.N.*
&c. &c.

Office of Public Works,
SIR, *21st January,* 1845.

The Commissioners have received your letter of the 9th instant, which transmitted a memorial from many commanders of steam-vessels, trading to the port of Dublin, and which suggests the substitution of patent screw moorings for those now used in Kingstown Harbour; and have directed me to inform you, that their representation was immediately referred to the Harbour-master, who, while he declares his respect for the opinion of so many experienced seamen, cannot coincide with them in many of their propositions.

APPENDIX B.

KINGSTOWN.

No. 28.
Correspondence relative to Screw Moorings.

With regard to the Screw Moorings; of the two laid down by Mr. Mitchell, one has given way near the shank, and in consequence the screw remains in the ground irrecoverable.

The subject of the application will remain on record, for due consideration, in any future arrangements in the harbour.

I am, &c.,
HENRY R. PAINE,
Secretary.

J. Hirste, Esq., "Jupiter Steam Ship," Dublin.

SIR, *Dublin, 31st January,* 1845.

I beg to acknowledge the receipt of your letter of the 21st instant, in reply to a Memorial from the masters of steam and sailing vessels, praying the Commissioners to substitute the patent screw moorings, in Kingstown Harbour, for those at present laid down there, as the means of affording additional safety, in gales of wind, to vessels in that harbour.

Informing us that the Commissioners immediately referred the subject of the Memorial for the consideration of the harbour-master of that place, who, in reply, expresses his respect for the opinions of Memorialists, but cannot agree with them in many of their propositions. Having communicated with Memorialists, I am desired to express our regret that the Commissioners have not deemed it necessary to extend their inquiries into the merits of the plan suggested beyond the harbour-master; who, while we entertain the highest opinion of him as a gentleman and a seaman, were prepared to expect that our plan would not meet with the approbation of that gentleman, tending as it does to disapprove of the present moorings, which have no doubt been laid down by him, or under his guidance. We wish to be clearly understood as not in the slightest to reflect on the character of Lieutenant Hutchison as a harbour-master, as we believe a more active, zealous, or efficient officer could not be placed in the situation he holds. Still, many clever men are so wedded to their own opinions, that it is difficult to persuade them that any improvement could be made on any plans suggested superior to their own; and as this plan did not emanate from that gentleman, we are not disappointed at meeting with opposition from him. Still we did presume to hope that the opinion of so many men, who have spent the greater part of their lives at sea, and whose varied experience must enable them to form a pretty correct judgment as to the best mode of securing their vessels from danger, would have had some weight with the Commissioners on a matter of so much importance to the shipping interest.

With regard to your remark, that one of the two screw moorings laid down gave way at the shank, leaving the screws in the ground, and, consequently, irrecoverable, is no proof that they are to be generally condemned, but evidently a want of the requisite strength, or, what is more likely, a flaw in the iron. As well it may be urged against the use of anchors, that as they frequently break, and parts are left in the ground, they are not to be depended on. I let go an anchor in Kingstown Harbour, on the 22nd March, 1842, during a gale from the southward, which, on heaving up, I found the stock broken and gone; it having caught the moorings, which I believe are laid from east to west, and which renders it next to impossible to avoid fouling your anchor, unless let go on the west side, or near the entrance. In the present state they are a complete trap for vessels' anchors. On another occasion, in 1841, during a gale from the N.N.E., I took refuge in this place; and the harbour being full, let go my anchor (as I thought in time) just inside the piers, and veered out to 60 fathoms; but the grounds being so much cut up, drove until hooked by one of the chains. The weather moderate in the morning, I had to slip and leave my anchors, and proceeded to Glasgow. On my return, the moorings had been hove up by the chain lighter, and I saw two anchors hooked to the same chain, besides my own.

I was, with other masters of vessels, an eyewitness to the wreck of the barque Kingstown and brig Capricornus, with four other vessels, on the 1st and 2nd November last, and we are of opinion that had there been moorings along the west side of the harbour, the most of these would have been prevented. The brig had two anchors down, which would not hold her, and, in a harbour of refuge, became a total wreck, with five or six others, I believe; and they are not, I regret to say, the first by many that have been sunk and wrecked in this harbour.

For the efficacy of the screw moorings, I would respectfully suggest that reference be made to the Ballast Office, who have six of them laid down in the harbour of Dublin, subjected to the severest tests continually.

There are 13 laid down in Greenock Roads and Harbour, which I believe give the highest satisfaction, each often holding two large vessels entirely, during hard gales from the eastward.

We have no doubt that Lieutenant Hutchison will agree with us, that with so many proofs of the insecurity of this harbour, it is absolutely necessary that something should be done at once to make it in reality, what it is now only in name—a harbour of refuge.

Enclosed I send you two letters from the harbour-masters of Glasgow and Greenock, as to the security of the screw moorings; which you will please to return at your earliest convenience after perusal.

I am, Sir, &c.,
J. HIRSTE.

We, the undersigned, being all the Memorialists in port at this time, request Captain Hirste to forward to the Secretary of the Board of Public Works a copy of this letter, as our reply to that gentleman's letter of the 21st Jan., 1845.

JOHN HYDE, Commander of *Shamrock Steam Packet.*
G. HYOINSON ,, *Devonshire Steam Packet.*
WM. WILLIAMS ,, *Duke of Cambridge Steamer.*
WM. STOKE ,, *Eagle Steamer.*
ABSOLOM CHURCH ,, *Queen Victoria.*

COURTOWN.

No. 29.
Farrell, on the proposed Improvement of the Harbour.

No. 29.

COURTOWN HARBOUR.

Report of MR. J. B. FARRELL, C.E., *upon the proposed Improvement of Courtown Harbour.*

MY LORD, *January,* 1846.

To render the opportunities that nature afforded for harbour purposes, at Courtown, available to the greatest extent, the works that have hitherto been erected ought probably to be removed altogether.

APPENDIX B.

COURTOWN.

No. 29.
Farrell, on the proposed improvement of the Harbour.

But as such a course would involve too great an expense and delay, I have, in accordance with your Lordship's instructions, made the accompanying design with a view to improving, as far as appears to me possible, the present harbour.

I do not think that (without incurring an expense inadmissible in a commercial point of view) anything more than a fishery harbour, that would also be sufficient for local trade, can be expected. In attempting to do more, I fear the result would be doubtful, no matter how great the cost. But as the value of the fishery in this locality is considerable, and as with all its present disadvantages the trade of the port continues to be of importance to the country and neighbouring town of Gorey, the improvement of the harbour is a matter of no small interest.

It appears to me, that the great mistake committed was attempting too much at once, and that if, instead of trying to make an asylum harbour in the first instance, a single pier had been built out into deep water, and all improper interference with the set of the tides and local currents avoided, a great deal of good might have been effected, for which there were considerable natural capabilities. The erection of the northern jetty has been, I think, productive of injury. The drift of sand along the whole coast of Wexford is from south to north. The tide of flood carries it round the southern jetty, and in its progress northward, being checked by the opposite projection, the sand is caught and deposited at the entrance to the harbour.

No increase of sand takes place on the north side of the north pier. The current of ebb, following in some degree the line of coast, appears to keep it quite clear; assisted, most probably, by an eddy, in-shore current. One of the principal objects that I should hope to attain by the execution of the works that I now propose for your Lordship's consideration is, to prolong this cause and effect from the back of the north pier, across the mouth of the harbour to, and along the face of the proposed extension of the south pier.

Observing the effect produced in the current of ebb by its meeting and joining with the stream flowing from the "New Channel," I found that their combined forces passed to the east, from the end of the southern jetty, in a curved line: in the direction of which I would carry out "the proposed extension," as shewn in red upon the map. And in order that the current from the north should approach this addition with the least possible interruption, and flow gradually into the curve along its face, I would remove the present northern piled jetty. Another advantage arising from this removal would be the prevention of the accumulation of sand in the mouth of the harbour; as the tide of flood, after the extension was carried out so far beyond the end of the old northern pier (that should be allowed to remain unaltered) would sweep unchecked across the harbour, carrying with it the sand and other matter held in suspension to the shore above.

It would be well to extend the proposed addition 300 feet from the end of the present southern pier. But as, from the scarcity of stone in this neighbourhood, works of this nature are unavoidably expensive, I have drawn up the accompanying plans for only 100 feet, and, should the experiment prove successful, as I am strongly disposed to think it would, I have little doubt that the further extension together with any additional works that might be found requisite for increased shelter and accommodation, would soon become necessary, in order to satisfy the enlarged trade that would most probably follow the execution of the works now proposed.

The new pier would be of stone, to low water mark of spring tides, having three rows of piles, well tied together, protecting them and forming over this level, with proper wating-pieces and sheet-piling, a frame and casing to be filled with concrete, on which the usual heavy paving would be set. The cost would be about 2,000*l*.

I have the honour to be, &c.

To the Right Honourable
The Earl of Courtown.

JAMES B. FARRELL, *C.E.*

No. 30.
Account of Arrivals, Goods Landed, Shipped, &c., at Courtown Harbour.

No. 30.

ACCOUNT OF Arrivals, Goods Landed, Shipped, &c., at Courtown Harbour, for three years and eight months, ending April the 30th,

		1843	1844	1845	Dec. 31st, 1845
Arrived inside—					
Boats fishing		335	663	427	942
Boats trading		99	145	135	123
Yawls fishing		..	..	..	286
Total		434	808	562	1351
Arrived outside		83	51	44	58
Landed coal, fish, &c.	Tons	5,582½	4,226¼	3,835	4,302¾
Sundries shipped	Tons	136¼	164¼	111½	119
Harbour dues received		£193 6 3½	£122 7 1½	£201 13 10½	£147 5 3
Wages, repairs, &c., paid		204 8 4	124 8 5	198 9 9	166 17 2

POULDUFFE.

No. 31.
Memorial of Landed Proprietors and others.

No. 31.

POULDUFFE—CAHORE POINT.

Poulduffe Fishery Pier and Harbour, Cahore Point, County of Wexford.

October, 1839.

THE Memorial of the undersigned Landed Proprietors, Farmers, Boat-owners, Fishermen, and others, humbly showeth—

That the eastern coast of the County of Wexford, from Courtown Harbour on the north, to the Tuskar Light, and the Harbour of Wexford on the south, a distance of nearly 30 miles, is entirely unprovided with any harbour, or adequate place of shelter for boats or larger vessels.

APPENDIX B.

POULDUFFE.

No. 31.

Memorial of Landed Proprietors and others.

That extensive fisheries are carried on at various places within these limits, and a large proportion of the trade of Liverpool, and other large commercial towns in England, as well as Ireland, passes through the channel adjacent to this coast.

That the want of such a harbour causes annually, a vast loss of life and property, not only to the persons engaged in the fisheries, but to those interested in trade generally.

That independent of cases of total loss, great difficulty and hardship are experienced by the fishermen in dragging up their boats of eight or ten tons burden, above high water mark, on an open beach; the severity of this labour frequently preventing boats putting to sea in weather when (if afloat) they might easily be engaged in the fishery; and in the case of vessels lost upon the dangerous banks which bound this coast, it is equally difficult to put out boats to save their crews or cargoes, or to bring them to land, if saved from instant destruction.

That the natural harbour or anchorage of Poulduffe, in latitude 52° 29′, and longitude 6° 19′, situated on the northern extremity of Cahore Point (the most advanced easterly point of the county of Wexford), and sheltered by this elevated headland from the prevailing south and south-westerly winds, affords the best, if not the only safe anchorage along this coast; and offers great facilities for the construction, at a very moderate expense, of a shelter pier or harbour, which would be of infinite service to the above coast, and the country at large.

That a stratum of natural rock, exposed at low water, and projecting from the headland for 60 or 70 yards into the sea, affords a simple and secure foundation (free of expense) for a pier—it being, in fact, only necessary to assist nature, by raising the natural rock with stonework to a height of seven or eight feet; and stone in great abundance is procurable close to the pier.

That four or five streams in the immediate neighbourhood, form a considerable backwater, and may (if desirable) be made, at a small expense, to scour the proposed harbour parallel with the pier.

That within, and sheltered by this natural barrier of rock, there is a depth of from five to nine feet water, with a channel of seven or eight feet out to sea, sufficient, even now, and amply sufficient, if protected by a higher pier, to give shelter to the fishing and other boats which frequent this anchorage; and to allow grain and other produce to be embarked; and coal, lime, and other materials to be brought in, the difficulty of procuring which at present operates as a bar to the prosperity of the district.

That upwards of 25 fishing-boats, of from six to ten tons burden, besides smaller craft, belong exclusively to the fisheries of Poulduffe, and give employment to seven or eight persons each boat, or about 200 persons, affording at the same time the principal means of support to the families (numerous as they are) of these persons, dependent almost exclusively on the fishery for support; besides which, Poulduffe, from the security of its anchorage, is frequently the resort of more than 100 boats from the fisheries of Glyn, Morris Castle, Ballyvalden, and other places in the district, and even from the more distant ports of Arklow and Wexford, as well as of the Cornish and Isle of Man fishing-boats.

That from the fact of this harbour being opposite an opening of the great chain of banks which bound this coast, and from its prominent position at the base of Cahore Point, which, with its tower, is a conspicuous landmark from sea, Poulduffe is the point for which the crews of vessels wrecked on these banks uniformly make; and within the last 12 months, the crews of two large vessels—24 men from the "Indian Chief," and 14 men from the "Water Witch"—were saved, and found shelter at this point.

That the tower on Cahore Point was formerly a Government telegraph station, and is now occupied by the Coast Guard, thus affording increased security for the lives and property of persons wrecked on this coast.

That the district adjacent to this coast is densely populated by an agricultural and seafaring population, to whom the proposed harbour would be of incalculable benefit.

That the localities have been carefully, though not officially, examined by several engineers, and other scientific men, who have been uniformly of opinion that such a harbour would be of great utility, and practicable at a very trifling expense.

> Your Memorialists therefore earnestly suggest, that Poulduffe should be surveyed by competent persons, under the directions of the proper authorities, and that such steps may be taken for the formation of a harbour, or the erection of a pier at this spot, as may be deemed advisable. And Memorialists will pray, &c.

[Signed by several hundred persons.]

No. 32.

Mr. FARRELL's *Report on Poulduffe Harbour.*

No. 32.

Farrell's Report.

Wexford, *26th September*, 1842.

THE small harbour of Poulduffe, situated on the northern side of Cahore Point, in the county of Wexford, would be one of considerable importance, both as a fishing-station and landing-place for the general purposes of the neighbourhood, if a facility for launching, loading, and unloading boats were afforded at all times of tide.

The fishery off the coast, at this point, is considered valuable, but almost totally neglected in consequence of the difficulty of getting to sea.

The same difficulty has been frequently the cause of total failure in the best exertions to save life, in cases of shipwreck, as is set forth in the memorial of the inhabitants of the country neighbouring the harbour.

This document was drawn up, and numerously signed, for the purpose of obtaining Government aid towards the erection of a pier.

One of two results would be likely to follow the execution of such a work: the sand (the encroachments of which create the great difficulty to be overcome in projects of this nature, on the Wexford coast) would either fill up the harbour, and thus destroy the little natural advantages it possesses, or be checked in its progress at the same time that a current might be created, along the face of the pier, by which the basin would be scoured, and a constant depth of water, greater than the present, established.

From the evidence of those resident on the spot, and most interested in preserving as well as improving its natural advantages, it appears that the injurious drift of sand is from the south-east, and

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Farrell's Report.

that a strong current sets in from the north-east along shore, inside the banks, which, when the wind is from the former points, meets the sand, and a deposit takes place, in the shape of a ridge, along the proposed site of the pier. When the south-east wind is not prevalent, this ridge is swept off, and the rock, lying about four feet under it, is completely exposed.

It may, therefore, be fairly expected, that if the sand tending from the south-east be checked, by running a pier out, as shown in the accompanying plan, and the current from the north-east met by it, and led along its face, a deeper channel would be formed and continued out in a south-easterly direction, cutting off the tail, and probably the entire, of the southern bank, outside the pier head. The sand thus removed would, of course, be deposited in the neighbourhood, and probably increase the banks towards the north; but this would not be of any injury, as the great object to be attained is, not the formation of a harbour of any considerable extent, but merely a channel with sufficient depth of water to permit boats, of from 10 to about 30 tons burden, to land and get to sea when required.

The value of such accommodation is worth the cost of the experiment, which, it is my impression, would be successful; and there does not appear any danger of making the harbour worse than it is.

A pier, such as shown on the plan, could be executed at a cost within 1,000*l.*; a great proportion of which the inhabitants are, I understand, willing to contribute, and there is, therefore, every probability that Government would assist them.

H. R. Paine, Esq.,
&c. &c.

James B. Farrell.

No. 33

WEXFORD.

Wexford.

No. 33.

Evidence taken on the 29th Aug., 1845.

Examining Commissioner—Captain Washington, R.N., F.R.S.

Present:—Richard Allen, Esq.; John Howlin, Esq.; Captain Richards, R.N.; Captain Frazer, R.N., of H.M. ship "Lucifer," Admiralty Surveyor on this coast; Lieutenant Smith, R.N., Assistant Surveyor; Dr. Wardy; Mr. R. M. Hunt, Agent to Sir Hugh P. Palliser, Bart., &c.

Richard Allen, Esq., examined.—Is a merchant of Wexford, a ship-owner, a harbour commissioner, and has been for 26 years acquainted with the place. There have been no material changes in the harbour, except occasional shiftings of the sand on the bar. I have seen an old plan of the harbour, made by Captain Fanning, a sailing master, which showed the condition of the harbour at the time it was made, about the year 1799. There was a period, about 50 or 60 years ago, when the bar is said to have been worse than it is now. Old Benjamin Williams, a pilot, who is on our superannuated list, and receiving a pension, has told me that it was much worse at that time.

Commissioner.—I find, in the report of Sir John Rennie, made in 1831, that in 1808 there were 14 feet water on the bar. How has it happened that it has since been less, and is so now?

Witness.—The present bar is not grown worse, but better. There are three bars—the North bar, the South bar, and Hantoon. Hantoon was formerly the worst, but it is now the best. A band-dredge was employed in lowering and breaking it up, pursuant to a suggestion of Captain Frazer three or four years ago, and it has not since increased; but we had no funds to procure a steam-dredge. It would cost 3,000*l.*, and we could not raise the sum. The Act of Parliament empowers the Harbour Commissioners to borrow 6,000*l.*, but restricts them to that sum. They owe a debt of 4,600*l.* already. They could, therefore, borrow only 1,400*l.* more. The result of their inquiries in regard to a steam-dredge was, that it would cost 3,000*l.* They knew that they could not borrow so much. They were accordingly obliged to abandon the idea of procuring the dredge. The standing items of expenditure amount to about 1,000*l.* yearly in round numbers. Our income is about 2,400*l.* a-year;—15,000*l.* were expended on building quays and in bringing pipe water into the town; and contingencies have arisen to swallow the rest, and leave the Commissioners in debt 4,600*l.* besides. The interest of the debt makes one of the items of standing expenditure. The others consist principally in the salaries of officers, the maintenance of the pilot establishment, ballast establishment, buoys, perches, and lights, and the repair of the quays. The debt itself was mainly contracted for the erection of the quays, which were finished in 1827. A sum of 1,700*l.* was expended in one year, in consequence of a suit at law in procuring water for the inhabitants. The quays have sufficient foundation, and have at times 15 feet water alongside. They are built on a framing of piles, which project, but are not considered dangerous; they may, however, cause accumulations. It would be desirable to have a portion of the income expended in improvements; but hitherto, unfortunately, it has been required for different purposes, and the several items of standing expenditure come heavy upon the whole. In the sum of 2,400*l.* returned as the revenue for the last year are included the sums paid as salaries of officers, paid for ballast, and under the other heads I have mentioned. The Commissioners are not paid. There has been damage, from time to time, arising from want of proper moorings.

Commissioner.—Are you aware of the damage which occurred to the "George," the "Lark," the "Moira," the "Marquis of Ely," and other vessels in the harbour?

Witness.—I am. The "George" was driven against the quay. The "Marquis of Ely" was driven against another vessel. Both were injured. But I should say that it was rather from want of sufficient mooring they suffered than from exposure. I think that the accidents which have occurred in the harbour arose generally from want of sufficient mooring. There might be some advantage in docks but I think it would be more than counterbalanced by the disadvantages.

Commissioner.—Do you not think that mudlands, banks, and all projections that cause still water, are injurious by preventing the clearance of the harbour, and scour of the bar, which would be effected by a regular flow and reflow of the tidal water?

Witness.—Of course projections are injurious, so far as they have such effect. However, it would appear that such is not always the effect of projections or recesses. There is no sediment in the Crescent. I believe that Wexford bridge does great injury to the harbour, by causing deposits, and preventing the regular flow and ebb of the tide; the tide is not so high above the bridge as below it. I do not know any reason why the tide should not be as high at Enniscorthy as at Wexford bridge, unless the level of the river may be different. A good deal of improvement could be effected by

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reclaiming the slobs, if we had sufficient funds for the purpose. There is a vast number of vessels wrecked every year round the coast from Hook Tower to the Blackwater Bank. I think that a harbour of refuge would be of great advantage. It should be constructed in some place between Carnsore Point and Wexford. In the South Bay it would be more convenient, and of more advantage to the trade of Wexford than at any point further outwards. The arrivals and departures are about 800 each a-year. The tonnage is about 18,000 for steamers, and 57,000 for sailing vessels.

Captain JAMES CARR examined.—What is your occupation?—I am now master of the "Town of Wexford" steam-boat.

How long are you acquainted with Wexford?—I am now acquainted with the harbour of Wexford for 20 years, and for seven years filled the situation of harbour-master.

Have any changes taken place in the harbour since you were first acquainted with it?—I think it is in the same state. The revenue for the last year was 2,437*l.*, none of which was expended in improvement, unless in keeping up buoys, perches, and the like.

Do you think the piles that are in the water injurious?—I do; and I should think that if they were so in any other place they would be removed.

Does damage occur from the exposed state of the harbour?—Ships are frequently injured by having their planks stove from the action of the waves and swell. The dues are the same as in Dublin and Waterford?

Why have you ceased to be harbour-master?—I cannot state the reason, unless it was in regard to the docks that were proposed. I went to London and told the truth in my examination on the subject; and unless it was for that I was dismissed, I do not know what was the cause. I never neglected my duty: I did it by day and by night. I do think my dismissal arose out of some private or party feeling. Before my appointment as harbour-master, I had been navigating it for some years, and I did know it then better than I do now; but I have still a tolerable knowledge of it. I think the bar could be improved by a steam-dredge. There are not sufficient lights near the harbour, I think; a light should be put on the south end of Blackwater Bank. That part of the coast is in charge of the Ballast Board in Dublin. The lights of the inner part of the harbour are good, so far as they are kept up; but more are wanted. The outer part of the harbour should be lighted as well as the inner. The Tuskar light revolves once in three minutes; I do not think it is too slow. There is no danger of having it mistaken for the Saltees light. I think there is a want of buoys. Some of them are too small. Some of them are black, and more white; but, whatever the colour, many of them are so small that they might as well not be there at all. Besides this, the beacon-staff is not long enough. On some the beacon-staff is not more than 18 inches. There is no bell buoy to give warning. Nothing but the sand-banks, till you are on them. There was a vessel wrecked in the harbour, and the mast rising above the wreck served as a beacon while it remained; but it is now gone. Wrecks are both frequent and numerous. I think a harbour of refuge would be a great advantage. There is a good point in the South Bay; I would say about Ballygeary it should be formed. The South Bay is a harbour in itself, sheltered against several winds, and only requiring to be protected against some others. It is preferable to any other point on the outer coast. Mostly easterly gales of wind cause the wrecks; and the vessels are those navigating from the Clyde and the Mersey, and from the ports in that direction. By some improvement they could be sheltered in the South Bay against the easterly and northerly gales; and the bay is naturally sheltered against the westerly and southerly, from which those vessels also suffer occasionally. The bay is sheltered from the Carrigh and the Commins, and from the south winds. I would extend a north pier about a mile, and the south about a quarter of a mile from the shore, where would be a depth of water of 2½ fathoms—at half a mile four fathoms—from the rocks, a little more than a quarter of a mile, three fathoms. I think there are sufficient pilots. A vessel would be safe in entering the outer harbour at night by moonlight; of a dark night, it would be dangerous. If the bar were lowered by a steam-dredge, I think it would remain so, for some time at least. The scouring power of the tide would be increased by the improvement of the harbour. The Wexford bridge is an impediment to the regular flow and ebb of the tides. There is a rock in the harbour below the bridge which might be blasted by gunpowder; and I think if it were in any other place that it would. The Harbour Commissioners never proposed getting it blasted. I think that, if there were an officer who would look after improvements, the Commissioners would soon look after him. I never kept a register of the tides, and never was required to keep one. If the river were free from impediments, I do not know any reason why the tide should not rise as high at Enniscorthy as at the bridge of Wexford, unless the height of the bed of the river might cause a difference.

Captain FRAZER.—You have named Ballygeary as the point for the harbour of refuge. Are there not dangers between Tuskar and Ballygeary? Are there not the Mahouns, the Gypsey, and other obstructions?

WITNESS.—I think they could be readily avoided. Dredging is necessary to the Haatoon Channel. The projecting points of the slobs do injury by obstructing the regular flow and ebb of the tide. Damage is done to vessels by the state of the quays. Docks would be of great service.

Captain FRAZER.—If the harbour of refuge were made on the north side, would it not be safer than in the South Bay?

WITNESS.—I do not think it would. The north is exposed, but the South Bay is sheltered.

Captain FRAZER.—But would not the sand-bank opposite the South Bay render the approach dangerous?

WITNESS.—The sand-bank is a good way out, and could be avoided. A buoy is wanted on the south end of Howlin's Bed.

Captain FRAZER.—Would you not think a harbour somewhere on the coast of Carne preferable to one in the South Bay?

WITNESS.—I do not know so much about that coast.

Mr. HOWLIN.—It is only because be knows the South Bay best, that he gives it the preference.

Mr. ALLEN.—Would a pier at Carne be of any advantage to the trade of Wexford?

WITNESS.—Not so much as in the South Bay. There is no such thing as a life-boat, unless one out of order, in the care of the Water Guard. I never saw it used, nor did I ever hear of it being used, or see it afloat. I never saw nor heard of any rockets.

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Mr. ALLEN.—I do not think that a life-boat could act with success at the Blackwater Bank, where lives are generally lost. Few lives are ever lost on the other side, and wrecks generally take place outside the bar.

Mr. HOWLIN.—Several ships have been lost crossing the bar, as well as westward of Carnsore Point.

Dr. WADDY.—The "Hawk," the "Sarah," the "Union," the "Selina," ond other vessels, were lost over the bar. The "Edniada" a large vessel from America, was lost in 1840.

Mr. HOWLIN.—In March, 1844, the "Georgiana" was wrecked, and 11 lives lost within 4½ miles of the bar.

Mr. ALLEN.—Vessels are generally lost in the North Bay. Those driven into the South Bay are always saved. There should be a life-boat stationed at Roslare, and another in the North Bay. There is no encouragement given for the preservation of life and property. The men who exerted themselves for saving out of the "Edniada" were very badly paid. There was one man of mine who exerted himself, and he got but a guinea. I was myself badly paid for exertions I made in saving life, and for giving clothes to the persons saved.

JAMES B. FARRELL, Esq., examined.—Is County Surveyor, and has resided in Wexford upwards of five years. I have given a good deal of consideration to the subject of the harbour, and am decidedly of opinion that its state could be much improved. I am of opinion that the line of quays could be improved. I was engaged in making an examination of the river preparatory to carrying out a project for the establishment of a free bridge, instead of the present upon which toll is charged; and this examination, coupled with previous observation, led me to the opinion that much improvement was required, and could be effected. I think that the present bridge is very injurious to the harbour, in causing an accumulation of mud, and thereby obstructing the regular flow and ebb of the tide, and diminishing its scouring power.

COMMISSIONER.—Judging as an engineer, and after the examinations you have made, can you conceive any reason why the tide should not rise as high at Enniscorthy as at the bridge of Wexford?—I do not know the exact difference of level between these points; but, apart from this, I know of no reason why it should not, if the bed of the river were lowered sufficiently and all obstructions removed so as to regulate the velocity of the stream. I made an approximate calculation of the relative capabilities of discharge at Ferrycarrig bridge and at the bridge of Wexford, in order to ascertain the amount of damage done by the contraction of the river at the latter, and arrived at this result; that, assuming the rate of fall through both to be two feet per statute mile, the sectional area of the river, at low water, spring tides, under Ferrycarrig, which is about three miles and a quarter higher up than Wexford bridge, would afford capability for discharging 374,948,006 cubic feet of water per hour; while at Wexford bridge the calculation gives only 332,773,689 cubic feet per hour. At Ferrycarrig bridge, therefore, the river is capable, under the present circumstances, of discharging 42,174,317 cubic feet per hour more than at Wexford bridge, though so much further down, and though between the two points there are added to the waters of the Slaney those of the Sow and Castlebridge rivers, and other minor streams. The sectional area of clear waterway at Wexford bridge is 11,529 square feet at low-water spring-tides: at a point a quarter of a mile above it the sectional area is 14,918 square feet, being greater than the former by 3,389 square feet. To unprofessional persons this will appear more striking by comparing this difference with an equivalent column of water placed between the stone causeways at each end of Wexford bridge where it would occupy a space four feet six inches high over low-water mark. This large mass is prevented from passing into the main tidal basin with the ebbing tide, and from flowing upward with the flood, by the construction of the waterway, and so much influence worse than lost that ought to be exerted upon the channel of navigation. The contraction of the width of the river, at Wexford bridge, must have torn up the bottom and deepened the stream by creating a head of water and consequent increase of velocity. To obviate this, which was likely to sweep the bridge away altogether, large stones were, I understand, from time to time thrown in, until an artificial bar has been raised about, I should think, eight feet high. The injurious effect arising from such a state of things needs no explanation. The great velocity with which the water passes through, and away from this bridge, has very probably created a secondary bar inside the harbour's mouth. I think that the same measures should be adopted here, as have been successfully adopted in other places, for removing obstructions and causing the equalization of flow which is so essential.

Are you aware that on the river Tay, near Perth, means have been successfully adopted for removing similar obstructions?—I am not acquainted with that particular instance; but I know that successful means have been adopted for effecting such improvements in other places, and I think they might be so here. Great injury has been done to this locality by one circumstance. Heretofore the persons, proposing to effect improvements, came here as speculators, making the reclamation of the mud lands the primary object; the consequent failure of their projects served, in some measure, to bring discredit on all proposals for improvements. By increasing the flow and reflow of the tidal water, by narrowing the channel, and removing projections, the bed of the estuary could be kept more clear, and the scour on the bar increased. The present bridge does a great deal of injury, and there is a vexatious toll levied on it, both on vessels passing through, as well as on passengers going over.

COMMISSIONER.—Is there any authority, by Act of Parliament, for levying tolls on shipping?—I cannot say. Mr. HOWLIN.—The charges are made. At Ferrycarrig, 5*s*. are charged for raising the portcullis.

Mr. ALLEN.—The charge here is 1*s*. per mast. I have paid it.

Mr. FARRELL.—The rocks immediately round Wexford are of quartz formation. The want of a sufficiency of good stone would present some difficulty. I have seen it stated that there is not any worm to destroy wood in the water here. It is a strange circumstence; but I have seen it stated. The piles of the bridges, when taken up, are not, I believe, found worm-eaten. The reason may be, because the water is too brackish. The bed of the river is intersected by a ridge of rock about a quarter of a mile above Wexford Bridge, from that to Ferrycarrig—I am not aware of any similar occurrence—but at Ferrycarrig I suspect the bed is rock. On the other side of Wexford Bridge, between it and the bar, there is rock again; but it is now a common engineering operation to blast rocks under water. I think that the improvement effected in the harbour would afford compensation for the expense which would attend such operations; but as I said

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before, the question being prejudiced by incompetent speculators, any proposition is coldly received. I do not think the bar could be altogether removed; but I think it could be pushed out into deep water. The great impediment to navigation would, of course, be thereby much diminished, if not altogether removed. I think that a harbour of refuge would be a great advantage. I have considered the question of position a good deal, but I should observe, however, always in connection with railway communication, which I believe would eventually take. It is, therefore, as taken in connection with a railway project that I would venture to say where a harbour of refuge should be formed. My opinion is, that it should be at some point between Carnsore and Greenore, or I would say more particularly between Wilkeen Rock and Cmssfenton Point. I cannot be more specific, as I am not sufficiently acquainted with the comparative advantages of different localities; and even my general opinion is given with the qualification, that additional information might serve to change or modify it. Perhaps one of the greatest difficulties would be to find stone fit for the purpose; there is no stone nearer than the Mountain of Forth or Carnsore, and I do not think the former would be fit. There may be other difficulties, but I do not think they would be insurmountable. There are difficulties in almost all cases; but it is generally worth while to encounter them. In this case, to use a common expression, I should say that the "bull should be taken by the horns." I think that improvements could be effected, which would diminish the loss of life and property. Besides improving the channel, and forming a harbour of refuge, I would recommend the formation of fishery piers, and even boat slips at different points which might be ascertained as available for such purposes. I believe such points can be found. I am now engaged in making a pier near Cahore Point, and I believe it was pretty generally thought that it would turn out a failure from the accumulation of sand; but by taking proper precautions, such, for instance, as placing the pier tangential to the current, already, though a portion of the work is done, the harbour has been deepened. With a good knowledge of the set of the tides, and, particularly, of the local currents and the general drift of sand, as well as other local circumstances, I believe that much good may be done at points along the coast which at present may be considered hopeless. There is a fishery pier in progress of erection at Kilmore, which is a very important point as a fishing station. It is opposite the Nymph Bank, where the fishermen might be profitably employed, but are unable, from want of proper accommodation for their boats, to be out when they ought; and in the mean time they have the mortification of seeing strangers taking away from them the value of money that would make them independent. They have been acting injudiciously; expending themselves, without proper guidance, in the erection of a pier, the sums raised by private subscription, instead of allowing them to accumulate and enable them to claim the additional aid that Government has the power to afford them. Without considerable assistance the work cannot be completed properly, and without it the natural advantages of their position are lost to them. I do not think a harbour at Carnsore, or at any point on that coast, would injure the town of Wexford. One in the South Bay would be more convenient to Wexford; but I always bear in mind a railway communication, which would render the difference very trifling. In other respects, I should think a harbour on the outer coast preferable; there are dangerous banks outside the South Bay. The Tuscar Rock, outside Carnsore, would be one of the great advantages that an asylum harbour in that locality would possess. The light would render it more easily accessible by night.

Captain FRAZER.—Would you consider back-water an acquisition, in constructing a harbour, or otherwise?

WITNESS.—I should rather have no back-water. Courtown harbour affords an instance of failure where backwater was resorted to. Back-water, if at all admissible, should only be used in conjunction with the strength of an ebbing tide; used otherwise it rather tends to cause deposits than to prevent them. Without any back-water, deposits would be less likely to be formed. I think all within the harbour could be effected without loss; and that the reclamation of the slobs would be amply remunerative, and furnish the means for effecting all the required improvements. I am strengthened in this opinion by what I find in a Manual of Agricultural Chemistry, applicable to the soils of Ireland, by Dr. Antisell. It is not generally known that, according to him, the alluvium of the Nile and the slob land of Wexford, when analyzed, present a strong analogy. I should say that the construction of docks would be of advantage, if they were properly executed; but as regards the particular docks proposed, I cannot give a positive opinion, as I have seen no sections. I believe that a certain depth of water was promised, and if a proper depth were ensured at all times of tide, no doubt much advantage would be obtained; but how far these promises could be realized I am unable to say from these plans, which are all I have seen on the matter. I think the Ballast Bank should not be allowed to remain. All projections that prevent the full and regular ebb and flow of tides are injurious, and should be removed. I would adhere generally to the present course of the river, but would endeavour to regulate the width and make the curves more gentle, in order, with other improvements, to equalize as far as possible the velocities of the ebbing and flood tides. The river ought to meet the latter with the gentlest possible inclination; I would contract the present tidal basin where the water spreads thinly over the slobs. A most important point to be ascertained is, what should be the limit of that contraction; by this the lines of the necessary embankments could alone be defined. This cannot be done with any approach to truth without a thorough engineering examination of all the circumstances, in order, first, to obtain a true knowledge of the disease of the harbour, if I may so express myself. This examination has, I believe, been never made. The best shape to give the channel of a river, in order to obtain the greatest discharge, is that which would afford the greatest hydraulic mean depth, or, in plainer terms, which would give the least amount of friction. The operations under the Drainage Act will throw much light on this subject; for some trials already made, the cross section, a diagram of which I now sketch, is perhaps the best:—Assume any width of bottom, and let the sides slope for about a fourth of the entire height, making a large obtuse angle with the bottom; from this up, let the sides approach nearer the perpendicular; the outline of this channel will resemble a semi-decagon. This shape has been found to afford a very large capability of discharge. The adoption of the best transverse section is of further importance, inasmuch as it would tend to economy, for it is more than probable that, heretofore, larger dimensions than were at all necessary have been adopted, thereby increasing, not only unnecessarily but injuriously, the quantity of excavation. A thorough investigation of the river should be made from Enniscorthy to, and perhaps beyond, the bar. About two feet per mile is the general inclination of large rivers; but I am not prepared to say I should adopt it here. The investigation which I have just recommended would enable me to decide on this point; but, speaking generally, the fall should be gradually diminished, so as to meet the tide as gently as possible. No individual could be expected to incur the expense that the full examination of this subject would

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be attended with. I intended to have made it to a certain extent, had I been able to procure Captain Frazer's Survey.

Captain FRAZER.—It could be procured upon application to the Admiralty, and by paying something for having a copy taken.

COMMISSIONER.—The Admiralty would afford all facilities, and the copy would be made for about 20*l.* or 25*l.* Surely the merchants ought to think it worth their while to expend that sum, which, to them, would be a trifling one, in promoting the inquiry necessary to the improvement of their river and harbour. Do you consider that, in the event of engineering improvements, it would be essential to have a register of the tides kept?

WITNESS.—No doubt it would be decidedly essential; and it would form one of the chief features of the investigation I have been recommending. The relative times of ebb and flow should be accurately ascertained both at the bar and up the river. I will venture to assert that there is considerable difference in this respect at present. I think Wexford Bridge a great impediment to the improvement of the harbour, and the causeways and piles an obstruction to the regular flow and reflow of the tidal water. I have been told, moreover, that stones were thrown down, 10 years ago, to firm the piles, and of course they form an additional obstruction, and cause a further accumulation of deposits. I do not think that the tidal water returning slowly from the slobs can do so much good in clearing the harbour as if it were confined within a regular channel. On the contrary, I think it calculated to hollow, to plough-up narrow passages in the sides of the channel, and thereby to throw a greater accumulation of deposit into the more central parts. I believe there are, by the sides of the channel, many passages thus hollowed, and I think them injurious. The waste of water causes a diminution of velocity in the bed of the channel, and the necessary clearance of the harbour is thereby prevented. In the meantime, the action of the water in those narrow passages further increases the accumulations. I think it would be of advantage to have the water withdrawn from the slobs; but the exact course in which it should be directed would depend upon accurate examination, which should precede any practical measures for improvement. I think that, without it, it would be madness to attempt anything. I think that the improvement of the harbour would serve to diminish the accumulations at the entrance, and that the point of accumulation would be removed. I think that deposits would be carried out further seaward. I understand that the Raven is increasing, and that Rosslare is decreasing. The tendency of accumulation, at present, is northwards.

Lieutenant W. F. ESSELL, R.N., examined.—A Lieutenant in the Royal Navy, and Chief Officer of the Coast Guard stationed at Carne, nearly 16 years. A great many wrecks have taken place during that time. Principally to the westward of Carnsore Point. There were three to the eastward, and, I believe, as many as 14 to the westward. I think a harbour of refuge ought to be formed somewhere to the northward of Carnsore Point, say about a mile and a half, wherever the greatest shelter could be obtained. I think that would be a better position than the South Bay, as it is out on the bold coast, where there are no such dangers to be encountered as there are opposite the entrance of the South Bay. The position of the Tuskar Lighthouse would be a decided advantage to it.

COMMISSIONER.—I have seen three piers or groynes at Carne, extending outward beyond low water-mark. May I ask by whom they were raised?

Mr. HOWLIN.—It was my privilege. I had a right to protect the strand.

COMMISSIONER.—The space between high and low water-mark belongs to the Queen.

Mr. HOWLIN.—I have my right to the strand secured to me by my patent, and by right of prescription, for upwards of a century. The height of tide at Carne is nine feet. In Wexford Harbour, it is four feet six inches. In the South Bay, it is the same as in Wexford. It increases round Greenore Point. Vessels have been ashore. I am speaking now of steam navigation; and, of course, the danger to sailing vessels is still greater. The result of my 16 years' experience is, that I think a harbour of refuge should be formed, and the inner harbour improved as much as possible. Everything ought to be done for the protection of life and property, of which the loss has been deplorable. Lieutenant Essell himself has frequently had to get poor creatures interred who had been lost in wrecks. There were three wrecks at one time.

Captain FRAZER.—You think it would be better to have the safety harbour on the outer coast than in the South Bay?—I do. A harbour in the South Bay would be of more advantage to the trade of Wexford; but I think general advantages would be in favour of the other position.

COMMISSIONER.—You think a harbour on the bold coast outwards would be of more advantage to the trade of Glasgow, Liverpool, and generally?—I do.

What has been the greatest loss of life by any wreck?—There were 11 lives lost by the wreck of the Georgiana.

Could a life-boat have been of any assistance in saving them?—The vessel was lost on the Blackwater Bank, and a life-boat would have been of no use. The life-boat in my charge is not in very good order now.

Has the service of it been requested from you on any occasion?—No; and in the cases of wreck which came under our own observation, the life-boat could be of no use.

Mr. MARK DEVEREUX examined.—I have been Superintendent of Pilots for 13 years for the harbour of Wexford, and reside at the Fort of Roslare. I am also Surveyor of Shipping for Lloyd's. There are 16 pilots in all: there are 13 pilots at the Fort, and three harbour pilots. They undergo no examination before their appointment; and are appointed by the Harbour Commissioners. They are selected from among persons judged to possess the necessary qualifications, and are kept for six months under my direction, before they are allowed to act. I am well acquainted with the different bars, and there will soon be another. I am obliged to put a buoy on it. Where the best channel is now, that is Hantoon, the bar, formerly, had only four feet of water on it. The buoys are sufficient in general. But we must sometimes depend more upon our knowledge of the channel. A vessel was sunk two years ago, and while the mast remained standing over the wreck it served as a beacon. It is now gone. I applied to the Ballast Board for a buoy to put on it, but have not got one. I know of no wrecks having occurred inside; but I know of no vessels having gone aground, and come off again. For 13 years, I cannot say that there were five vessels lost on the bar, or that there was any life lost. There is no life-boat in the harbour, nor on the coast, unless that in charge of the water-guard; and that I have never known to be used. We have saved lives with the pilot-

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boats. On one occasion we saved 11 lives from a vessel that was going to pieces, for which I received a silver medal from the Humane Society of London. I think a harbour of refuge would be a great advantage. I think the South Bay would be a good position for it, as it is already a harbour, sheltered against different winds, and capable of being easily sheltered against the remaining. I think that the banks could be readily avoided, and that vessels might run to the South Bay without any danger from them. The banks are not buoyed; but they are so far out that vessels would be in no danger of running on them. I believe applications have been made for an additional light on the coast; but the parties have delayed urging them until the Ballast Board should have first put a lightship on the Blackwater Bank, as it was expected they would. A light there would be of great advantage; and should be placed at the south end of the long bank. Vessels come into Wexford Harbour at all hours of the night. The light of Tuskar is the nearest to the harbour; the Saltees Light about 13 miles, and the Arklow Light about 24½ from the Tuskar.

Mr. HOWLIN.—What is the breadth between Greenore and Howlin's Bed? See what it is between the Perch of Carrig and the tail of Howlin?

Lieutenant SMITH, having measured, said it was rather under two-thirds of a nautical mile—or 1,200 yards to a channel of three fathoms.

Mr. HOWLIN.—That is the only way of beating into the South Bay, unless from Arklow.

COMMISSIONER.—Do you think that the South Bay would be the best point as a harbour, sheltered against different winds; and do you never hear of vessels being injured in it?

Mr. HOWLIN.—The "Town of Wexford" steamer, last year, broke from her moorings in the South Bay.

Captain DEVEREUX.—There is perfect safety when the wind is at the south-east. Vessels can then ride in the bay in the smooth water. We have to guard against a north-east wind, and nothing else.

Lieutenant SMITH.—The north point is nearly four miles distant; but there are outlying banks. There is one very dangerous bank; it is an entire bed of foam, at about a mile and a half, and extends for six miles.

COMMISSIONER.—Do you think a harbour would be safe with such a bank lying before it?

WITNESS.—I do, nevertheless, think the South Bay would be the proper place, and could be rendered safe by buoying and lighting. I do not know of any other point that could be rendered available. I was with Mr. Brunel, down in the South Bay, several times, and his opinion seemed to be that it was there a pier should be raised.

Mr. HOWLIN.—In his evidence before the House of Commons, Mr. Brunel only spoke of erecting a wooden jetty in the South Bay, and that for nothing but steamers.

COMMISSIONER.—What is your opinion on the comparative advantages of Carne or Saint Margaret's Bay, and the South Bay? Which do you think would be more advantageous to the trade of Wexford?

WITNESS.—The South Bay unquestionably.

Mr. HUNT.—If there were piers in both, why should one be of more advantage to the trade of Wexford than the other?

WITNESS.—Because it is nearer.

Mr. ALLEN.—If a vessel left the South Bay in the morning, and another left Carne at the same time, would not the one from the South Bay have arrived at Wexford, and been discharged sooner than the other could get up?

WITNESS.—There can be no doubt.

Mr. HUNT.—Do you think that, if a vessel had her sails split, and her masts sprung or gone, she would venture into a harbour in the South Bay, with the banks lying for six miles before it?

WITNESS.—I still think it would be better than the other. Roslare Point is diminishing, and will, I think, continue to do so, which is an advantage. I think Hantoon Channel could be deepened to full twelve feet at low water. The depth of the Cull, or Coal Channel, is, by Captain Frazer's survey, fourteen feet at low water.

Mr. HOWLIN.—I have known a tide to come up that channel some miles, and rise above Rathdowney several feet.

ROBERT HUGHES, Esq., Treasurer to the Harbour Commissioners, submitted their accounts from 1833.

The COMMISSIONER, having inspected the accounts, said they appeared to be regularly audited, and duly signed.

ROBERT MORRIS HUNT, Esq., examined.—I reside at Castletown House, and am land-agent to Sir Hugh Palliser; but I was heretofore Commander of a steamer to Wexford, and I also acted as commander in navigating the coast. I would not think it safe to enter Wexford Harbour at night, and I never ran in at night. Whenever I was off at night, I always stood for Tuscar, and remained there till morning. The buoys are very small, and cannot be seen until you are on them, or very near to them. I do not say but they serve their purpose well enough; but I would not like to enter the harbour at night unless it were lighted, nor at any time without intimate experience, unless under the guidance of an experienced pilot. I think a harbour of refuge decidedly essential, somewhere to the northward of Carnsore Point, at some point about Saint Margaret's Bay to the north of Carnsore. From Dublin to Cork, for a distance of more than 100 miles, there is not a single harbour of refuge. I, therefore, think it strictly essential that one should be formed somewhere in the locality. I do not think that one seaman out of a hundred would run into the South Bay, on account of the banks rising off. But a safety harbour is extremely requisite. The coast has been a very fatal one, and I do not know any place where a harbour of refuge is so much required. From Cork to Dublin there is no shelter. It is all, with certain winds, a lee shore.

Mr. ALLEN.—Vessels in the South Bay would be much better sheltered naturally.

WITNESS.—If in the South Bay, they would be much better sheltered certainly; but the difficulty is how to get in.

Mr. ALLEN.—There is plenty of a kind of coarse porphyry at Carne, and there is the same kind of stone at Greenore.

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No. 33.
Evidence taken on the 29th Aug., 1845.

JAMES MURPHY examined.—I am harbour-master of Wexford for about two months past, and I had been master of vessels for thirty years before. It is my duty to see the vessels properly moored. They are sometimes laid with their heads in to the Quay. It is not dangerous to have them so here, and lower down they are laid broadside on. Not much damage is done by an easterly gale. It has sometimes happened that vessels have been driven against the quays, and the stones of the quays driven in. There are no mooring-rings, but posts; no moorings nor buoys laid out in the river, but the one at Mr. Redmond's packet yard. I cannot exactly say that the bridge is an injury to the harbour. The place near the bridge is shoaled over the rock. It scours other parts. The water is deeper downwards; but here the bridge prevents scouring. I believe the rock is some injury to the harbour, but there is not much danger. One rock is buoyed, and there is deeper water inwards between it and the shore. The removal of the rock would cost 1,000*l.*; and the question would be, whether the money could not be more profitably employed. I think the harbour should be improved, and the bur removed before docks are made, to deepen the harbour and Hantoon. I do not know the slobs should be taken in. Before the slobs were meddled with, the harbour was better. I remember when an embankment was made, and before that the water in Coal Channel ran at the rate of nine knots an hour.

COMMISSIONER.—Who made the embankment, or what authority had they?

Mr. HOWLIN.—I do not know who they were; they were strangers. The principal party was a Mr. Thomas. I do not believe there was an Act of Parliament, but he got permission from Major Boyd, who has rights of his own over the place, which have not been questioned.

WITNESS.—When wrecks have taken place, the vessels generally were outward-bound ships from Liverpool, and other places with winds from the south or south-east, when they were outward-bound, and from the eastward when they were on their return. They were generally lost on the Blackwater Bank. When they were outward-bound they would have been safe if they could have run into the South Bay. They would then have been sheltered from the gales from the southward.

COMMISSIONER.—Can nothing be done to remedy the dangers of the Blackwater Bank?

WITNESS.—I have heard in Dublin that, when the lighthouse will be erected on the Conybegs, the light-ship will be brought here.

COMMISSIONER.—How soon might that be?

Mr. HOWLIN.—It may be fully two years. The lanterns of that vessel are heavy. They are not less than four tons weight. A harbour of refuge should be formed in the South Bay; it is the best place, for it is a harbour already, unless against some winds, and a pier would make it safe against all. Numbers of vessels, and of Wexford vessels too, frequently run from the South Bay to the Chour.

COMMISSIONER.—Do you think a harbour in the South Bay would be safer than one on the eastward coast?

WITNESS.—I do. The western gales drive round Carne, and the South Bay is sheltered against them. It is also sheltered against the winds from the southward. I have often anchored under Howlin's Bed. With the wind at south-east I would lie under the lee of Howlin. In my opinion the foundation of the quays is capital, and the quays are kept in capital order. I never knew any damage to be done by the piles. Masters look for a place where there are no piles, but when they cannot get there they put down fenders.

JOHN RICHARDS, Esq., examined.—I reside in Wexford, and am Secretary to the Harbour Commissioners. I have been Secretary to the present Harbour Commissioners for two years, and was Secretary to the foregoing Commissioners for 22 years; I have been in all Secretary for 24 years. They now act under the statute 6th and 7th Victoria, but that only extends the provisions of an Act of George III., which is the governing Act. There are 104 Commissioners. There were 50 under the old Act, and the others are qualified under the present.

Mr. ALLEN.—All who are possessed of a certain qualification are entitled. It consists of a house valued at 21*l.* a-year, and the possession of 100*l.* beyond all just debts and demands. There is a meeting every Tuesday, and all the members of the Board are summoned to attend. The attendance will be numerous when matters of importance are to be considered; on other occasions it will not be so great. The average attendance runs from about 14 to 50. There is no executive committee or committee of management, nor any executive officer but the secretary, unless those appointed to attend to the harbour and quays. There is a minute-book, and the accounts are kept. Mr. Cubitt made a Report on the state of the harbour, but it was not left at the Ballast-office. I do not believe it was a public document; I think it was made on private application, and from a private subscription. I believe it was published in the papers at the time, but it was not left at the Ballast-office. It was procured in order to meet some quack intermeddling with the harbour, and proposing to take in the mud-lands.

Mr. RICHARDS submitted the accounts of the Ballast-office for five years, regularly audited. The arrivals and sailings are 756 each, with a tonnage of 55,928. The Harbour Commissioners have the control of the pilotage. Many improvements have been made in the harbour; the quays were made, the Tuskar light was put up, and several things done. The works were executed latterly by contract, pursuant to public advertisement. About 300*l.* was expended in dredging. There is no other fund for effecting improvements besides the 2,400*l.* received by the Harbour Commissioners.

COMMISSIONER.—But was this sum altogether necessary to meet standing expenditure? Was there no surplus for the past year, or for any of the previous years, to expend on improvement?

WITNESS.—There was a good deal of expenditure besides the current. A good deal was lost in procuring a new Act of Parliament.

Mr. ALLEN.—There was a large surplus, but for the last two or three years it was swallowed up in the Parliamentary expenditure in procuring the new Act, which cost 2,000*l.*, in consequence of the opposition of an individual.

Dr. HARVEY said, that as Mr. Redmond's agent he wished to offer some explanation. Mr. Redmond was largely concerned in the trade of Wexford, particularly in the trade by steamers. In consequence of exertions already made, and others in contemplation, he thought himself entitled to have some clauses of exemption inserted in the Bill, and sought to have them so. He was at the same

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time engaged in promoting a Bill for the erection of new docks The parties seeking the new Act of incorporation opposed him on both grounds. Out of this arose his opposition, to the Incorporation Bill, or rather to certain clauses in it. He did not oppose it as a whole.

Mr. Howlin.—Carr's dismissal may be said to have arisen out of this. When the Bill for the new docks was before Parliament, Carr was examined as a witness. In his evidence he said that the tonnage of Mr. Redmond's steamers was 22,000 tons, which would have been the fact if they had been plying regularly; as they were off for some weeks, however, it was only 18,000 tons. His mistake was the sole or chief pretext for dismissing him. If there had been no opposition the cost of procuring the Act of Incorporation would have been about 700*l.*

Commissioner.—Then the opposition caused an additional expenditure of 1,300*l.*?

Mr. Allen.—Yes.

Mr. Barrington.—Mr. Redmond thought that, as he had erected quays for himself, he should be exempted from the rate. Other parties, however, had made similar improvements, and the Commissioners apprehended that they would be seeking similar exemptions if Mr. Redmond succeeded. In this way the revenue available for keeping the quays and the harbour in proper order might be frittered away, and all would be left depending on the separate or perhaps conflicting interests of individuals.

Francis Harpur, Esq., examined.—I am a ship-owner, and reside in Wexford. I am Agent for Lloyd's for more than three years, and for Liverpool and Glasgow seven years. On an average four wrecks have happened on the coast every year. Some of them were of very trifling value, and some of the vessels were large; there were two last year which were of considerable value. The value of one exceeded 40,000*l.*, and that of the other was about 30,000*l.*

Witness.—Had there been a light on the south end of the Blackwater Bank I think it might have greatly conduced to have saved them. There was one wreck to the east of Carnsore Point last year. I think the South Bay would be the proper place for a harbour of refuge. It is a harbour already, unless in certain winds, and if it were protected against these it would be perfectly safe. I have no complaints against buoys, perches, or otherwise, and have not heard of any; but I think a light on the Blackwater Bank would be of great service.

Captain Frazer.—Do you think that the loss of the mast from the wreck "Esther," outside the harbour, was a disadvantage to vessels entering?

Witness.—I think it was. I have heard masters express their regret for the loss, and have heard that the masters of vessels from Liverpool and other places were looking out and inquiring for it after it was gone. It was of great use; it was a very good guide. I think that if a lighter, with a proper mast and suitable stays, were sunk there, it would be of great use, but that would not have saved the two vessels last year. Both were from Liverpool. One of them ran right in, without touching any bank; the other, the "Georgiana," a large vessel bound for South America, struck on the Blackwater Bank. The crew took to the boats, and all were lost but two. If there had been a light-ship that might have been prevented.

Commissioner.—Do you think a light-ship necessary?

Witness.—I do. I have heard that the light-ship now at the Conybegs will be put on the Blackwater Bank when the Conybegs light-house shall have been erected, in about two or three years.

Commissioner.—Surely the coast should not remain as it is until then. Has any memorial been sent to the Ballast Office on the subject?

Witness.—I am not aware.

Captain Frazer, R.N., examined.—I am a Captain in the Royal Navy, and Admiralty Surveyor on the coast of Ireland for more than 22 years. I have surveyed Wexford Harbour and the outlying shoals.

Do you consider the buoys, perches, and lights sufficient?—I think there should be a buoy and perches on the south entrance into the South Bay, and a buoy on the south end of the Blackwater Bank—or I should rather say a light-ship on this end of the Blackwater Bank, and a buoy or beacon on the end of the long bank. I found sand-banks and shoals extending further north and south, and I found that Howlin's Bed extends further than is generally supposed. These observations apply generally to the water in the South Bay. The distance from the shore in the South Bay to the three-fathom edge is 1½ miles, 1 mile, and ½ mile—making an average of one mile, or thereabouts. I know the place spoken of in the South Bay as the position for the harbour of refuge; but I think any pier to be erected there would have to be carried out a great way to reach three fathoms water.

Captain Richards.—What is the distance from the Commins to Howlin's Bed, and the depth of water there?

Lieutenant Smith.—About two-thirds of a mile, and from five to seven fathoms water; and the holding-ground marl.

And is there not greater protection? Is there not, in fact, a kind of natural harbour formed there already, with two entrances?

Captain Frazer.—There is; and there are two entrances, one from the south and east, and the other from the north; the latter is a good entrance.

Captain Richards.—Then, with Howlin's Bed acting as a breakwater, do you not consider the place safe?

Mr. Howlin.—If it be safe, how does it happen that Wexford vessels very often run from the South Bay round Carnsore up to the Chour? I have seen 15 there at a time.

Captain Richards.—That may be. You cannot say, however, that the masters of such vessels are always thoroughly informed on the subject. Further information may change their opinions; and with their opinions they may change their practice. Could you not run in safety, keeping the Tuskar light south-south-east?

Captain Frazer.—I should be sorry to run in by compass bearings only.

Captain Richards.—If there were a pier, could it not be lighted so that a vessel could run in safely?—It could, but not from a light on shore. I would not like to multiply lights. The multiplication of lights would cause confusion, and increase danger.

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Which do you think, the South Bay or Saint Margaret's Bay, would be more advantageous to the trade of Wexford?—To the trade of Wexford I should say the South Bay; but for the trade from Liverpool, the Clyde, and generally, the outer bay would be the better.

COMMISSIONER.—You think they would like better to run into a harbour on a bold shore than into one with sand-banks lying before it.

WITNESS —I think they would.

Captain RICHARDS.—Should a light be put on the Wilkin Rock?—Of course, there should.

Captain RICHARDS.—Then would you not have the very thing to which you object—a multiplication of lights?

Mr. HOWLIN.—But consider the difference of depth of water. I should be glad to know how you would work out of the South Bay with the wind at south.

COMMISSIONER.—State what you consider the advantages of St. Margaret's Bay over the South Bay?—I cannot, for I have not surveyed St. Margaret's Bay yet. And I do not say St. Margaret's Bay in particular, but some place on that coast generally. Such a position I would consider preferable for general trade; but certainly the South Bay is decidedly preferable for Wexford.

Captain RICHARDS.—Would there be any difficulty in forming a pier in the South Bay?—I do not think there would.

COMMISSIONER.—Would there be any danger of an enclosed harbour silting up?—I do not think there would be any danger of accumulation of sand, beyond what could be removed by a steam dredge.

Mr. HOWLIN.—A letter published in the *Evening Packet*, of August 2nd, states that many thousand tons of sand are constantly carried away by the water. Where would that go?

COMMISSIONER.—In the course of your survey, has the necessity of improvement occurred to you; and what should be the nature of that improvement?—Decidedly. It occurred to me that interior improvement would serve to effect improvement outwards, and improvement is required both internally and externally, by dredging. I would seek to give a depth of 11 or 12 feeet of water on the Hantoon bar. I would not ask to carry it further. Then, by piling the outer side, and something like wicker work, so as to make it somewhat like an island, the run would always be clear. I do not approve of any entrance by canal.

Would you suggest any improvements within the harbour?—So far as might be necessary to lessen the number of projections, and give the channel its proper direction.

Are the accumulations adhesive? The northern channel runs over loose sand, that is affected by almost every breeze. On the southern side it is not so loose.

Would you change the course of the channel?—No; I would let the present channel alone, unless by endeavouring to render it more regular, and diminish its width.

Sir John M'Neill's opinion on the subject was something to the same effect?—Yes; and I agree with him.

Is the Gull Bar of rock?—It is not rock. It could be loosened.

How long is it since you sent to the Admiralty your plan of the harbour?—About two years.

A copy of it could be procured at a trifling charge?—Yes; for about 25*l.* The Admiralty are anxious to encourage improvements, and would afford every facility.

What would be the probable cost of dredging for a given time?—About 800*l.* would maintain the cost of dredging for a year.

Mr. HUNT.—Is there any danger of the bank becoming so altered as to close the entrance of the South Bay?—Captain FRAZER.—No; the tide would always keep a passage open.

COMMISSIONER.—Be so good as to state the rise of tide at Carnsore point, at the entrance by Rosslare point, and at Wexford quays?—The tide rises 10 feet at Carnsore point, and from five to six at Rosslare point and Wexford quays. It is high water on full and change at Carnsore point at 5h. 45m.; at Greenore point at 6h.; at Rosslare point at 6h. 30m.; and at Wexford quays at 7h. 10m.

The COMMISSIONER—seeing Mr. Redmond in the room at Kilmore—wished to know if he had any observations to make in reference to the evidence elicited at Wexford.

Mr. J. E. REDMOND.—Very few words. He was one of the most considerable owners of property in the town, and contributed nearly half the dues of the port. Being so far interested, he thought that it was not unbecoming in him to interfere, when they were seeking for the Wexford Harbour Act. The Commissioners made no improvement since 1796, except the quays, and he wished to have the money expended on the harbour, and the pilot establishment subjected to examination. He also objected to the body being so extensive as at present, as only a few are in attendance, except on particular occasions, when some specific object is to be attained.

COMMISSIONER.—Has no improvement been made in the harbour since 1796?

Mr. REDMOND.—Scarcely any, except the quays. Since that period between 50,000*l.* and 60,000*l.* were collected off the vessels belonging, and trading to, the port, as harbour rates, exclusive of pilot dues and ballast. Out of that large sum the harbour received the advantage of some 1,500*l.* or 1,600*l.*, principally in buoys. The object he had in view was to disconnect the harbour and quay rates. The quays were completed in 1826, and at that period the rate was only half what it is at present. The pilot establishment demanded an entirely new modification; they should be paid so as to stimulate their activity and industry, and not by the year as at present.

COMMISSIONER.—How far should they be at sea? Is Blackwater Bank within the sphere of their duty?

Mr. REDMOND.—Yes.

Mr. HATTON.—There are several instances of vessels hiring fishermen to bring them in.

Mr. REDMOND.—On one occasion, last year, the "Town of Wexford" steamer was obliged to slip her anchors, and hazard her passage over Hantoon. I am of opinion that the harbour should be deepened. An English gentleman proposed to deepen it a few years back, but he would not be listened to.

Mr. Allen then handed in the following statement:—

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To CAPTAIN WASHINGTON, *R.N., Commissioner of Tidal Harbours, &c.*

The notice of your former visit to Wexford being too short to admit of the Wexford Harbour Commissioners holding a meeting, as prescribed by their Act of Parliament, they have since appointed a committee to collect information relative to the best position for a refuge harbour on this coast. They lay now before you a statement of what they have been able to collect, which can be verified by Captain Denis Kenselah, for 22 years a master mariner out of this port, and since 1827 a shipowner residing at Wexford, and Captain Lambert, who is a master mariner trading to this port, and has been so for years. Those persons the committee consider, from their experience and intelligence, the best qualified persons to offer you any further information.

Pier in the South Bay.

There are no banks outside Wexford Bay, except Howlin's Bed and the Blackwater Bank.

These banks lie in a direct line, are not more than one-half mile wide, and have from five to ten fathoms water close to them inside, and also deep water at a quarter of a mile outside, with regular soundings.

There are neither banks nor rocks inside those banks, but clear bays from three to six miles wide.

The passage between Blackwater Bank and Howlin's Bed is about four miles wide—between Howlin's Bed and Greenore Point two-thirds of a mile.

If a lightship were placed on the south end of Blackwater Bank, that passage is perfectly safe to a stranger; and if a light were placed on the Carrig Rocks at Greenore Point, or on the projected pier end, that passage would be equally safe. Vessels belonging to the port come into the bay through the south passage by night by keeping the Tuskar Light bearing S.S.E.

If the above lights were placed, vessels could come into Wexford Bay at night as safely as into the Downs, or Milford and Cork harbours, and more safely than into Dublin Bay, where they have the Kish Bank far at sea, and another bank not lighted between Dalkey and Howth.

A light on the south end of Blackwater Bank is absolutely required to prevent the frequent shipwrecks on that bank.

The light on the pier could be so placed as not to be seen from the south or south-west, which would prevent confusion of lights, and would be as good a direction for the south passage as if seen from all points.

There being an efficient pilot establishment at Wexford, with able boats, vessels coming on the coast without proper charts or directions, would be supplied with pilots at a moderate and specific charge, to conduct them into the pier.

A refuge in Wexford Bay would prevent many shipwrecks; but in no other part of the coast, except Ballyteigue or Courtown Bays, for a vessel can fetch off any other part of the coast, and is only lost by running on the shore without seeing it. Here is a convenient anchorage also—not the case in Carne Bay.

The Bay of Wexford is enclosed either by banks or by land, and is subject to no sea except what rises inside the bank, and has consequently very little ground-swell.

The South Bay has no long reach to raise a sea, except between E.N.E. and N.N.E.; and with the wind on any other point is a safe road for all craft; and even with those winds large vessels can ride safely.

With the wind between south and north round by west, it is as smooth as many harbours.

The bottom of the bay is sand over marl, in four to seven fathoms water, and excellent holding ground, and very easy tides.

The wind between E.N.E. and N.N.E. being right down channel, never does any damage on this coast, and can never compel vessels to seek a refuge harbour at night.

With any other winds, all vessels can with safety anchor in Wexford Bay at night, and wait until morning to go into a pier, or get any assistance they require.

Should the wind change to a gale from the north-east, vessels can run to sea through the south passage, if they preferred doing so.

There is no wind but what will admit vessels to go to sea with ease, either by the north or south passage.

As there will be no ground-swell, the water will be quite still in the pier; and a comparatively small pier will accommodate the vessels, as they could lie in tier, and the smaller vessels near the ground.

Vessels with timber lie in Wexford Bay every winter from seven to twenty-eight days, to discharge part of their cargoes, and wait for spring tides to come into the harbour, and only one accident has occurred for 17 years, and that from defective ground-tackle. No loss of life has ever occurred in the South Bay from vessels driving on shore.

A disabled vessel can easily come into Wexford Bay, and anchor until assistance is given to get into the pier.

Vessels that are too large to come over the bar with full cargoes could there discharge into lighters, or if timber form it into rafts, and convey them to Wexford.

The vessels with timber are now obliged to do so in the open bay; and as it is necessary to have the water very smooth to make rafts, or for lighters to lie alongside, they are often detained for weeks in the bay. They could also remain in the pier while waiting for spring tides.

The only great improvement suggested by engineers on this harbour is, a ship canal, terminating in a pier in the bay.

There are 10,000 acres of valuable submerged lands in the harbour, and if the canal were made could be safely drained, as a basin to keep the bar clear would not then be required.

The Wexford Harbour Commissioners have been applied to by several persons, to exchange those lands for a canal and pier; but they have all considered that they were not worth the combined expense of reclaiming, and the canal and pier.

But the Wexford Harbour Commissioners have every reason to believe that they are well worth the expense of the canal and reclaiming, and that if a pier were made in the bay they would find no difficulty in procuring a company that would make and maintain a ship canal, with 14 or 15 feet water, from Wexford to it, in exchange for the mud lands.

The harbour of Wexford would then be put into the best and safest state, without any additional toll, and 10,000 acres of the most productive land added to this county.

To the fishery a pier would also be a great advantage. The entire space inside Hantoon and Blackwater Banks, a length of about 20 miles, is excellent trawling-ground, well supplied with sole plaice, and turbot.

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It has also several productive oyster-beds, which supply annually at least twenty millions of oysters.

It has also a herring fishery, and cod and other line fishing.

The banks protect it so effectually that there are not more than 10 or 12 days in a year that the sea is too bad in it to fish. Outside the banks are also several good fishing-grounds.

The fishing-boats of Wexford are, notwithstanding, yearly diminishing. It is principally to be attributed to the inconvenience of the port of Wexford for them.

Westerly and S.W. winds prevail most here, and with these winds boats must be at Wexford by high water and with daylight in winter; and if the high water occurs after 12 there is not flood enough of the next tide before dark to enable them to beat from the bar to Wexford—eight miles; and they must consequently leave the fishing-ground at 10 or 11, A.M.; and during easterly winds they are also obliged to wait for ebb tide to get out of harbour, and cannot reach the fishing-ground until afternoon.

If they had a pier in the bay they could fish until dusk and then run into the pier.

The neighbourhood of St. Margaret's Bay, Carne, is subject to very strong races of tide.

It is also open to the Atlantic Ocean at all points between west, south, and east, and to the channel between S.S.E. and N.N.E., and is therefore only sheltered between north and west—eight points.

With the wind from any other 24 points the sea is tremendous, especially at spring tides in wild weather.

As a pier there would be subject to heavy ground-swells, vessels should moor singly, and not near the ground, and there is not any safe anchorage in Carne Bay, with the wind seaward.

Two hundred to three hundred vessels are now often wind-bound in Milford Harbour, and fully that number must be expected at times in that pier. An unusually large pier would therefore be necessary; and even if large, it would at times be much crowded, and not safe for a vessel to run into at night.

If a vessel would run for the pier, and could not get in, she should go on shore, as there is no anchorage or road outside.

Masters at sea could not tell whether it was crowded, and consequently could never run for it safely at night.

Disabled vessels could never get into it in bad weather, unless the wind blew into it; for there is no place outside for a vessel to anchor until assistance could be had, and as a heavy sea will be running across the mouth, she could not fetch into it.

Vessels could not get out when it blew strongly into it; and a refuge harbour here should admit of vessels coming in and going out with all winds, for there is no wind that is not fair for vessels bound either up or down channel. It would not prevent shipwrecks on the coast, as no vessel is driven on shore there by the wind; but lost by running on the land without seeing it, for as the land occupies only about eight points of the compass, vessels can always fetch off in one tack or the other.

A light on the pier near Carne Point would be likely to confuse vessels, as it is often the first land seen, and vessels are already puzzled to distinguish between the Hook, Saltees, Tuskar, and the Smalls, and if another were added to the line it would increase the difficulty.

It would be vastly more expensive than a pier in Wexford Bay, as it should be much larger, and have walls much higher and stronger to resist the heavier sea. The difficulty from the heavy sea in making the pier in this quarter is much greater than in the South Bay.

It would be of no use to the trade of Wexford or Waterford; and from being placed in a point, and so near those ports, would have little trade of its own.

It would not be of much use as a fishing station, as the heavy sea in its neighbourhood would prevent boats leaving it when they could easily leave Kilmore or Wexford Bay. It is not as convenient to the fishing-grounds as either of the latter places.

There being no pilot establishment, vessels coming on the coast without charts or proper directions could not approach the pier.

Under all the circumstances we submit that, either as a packet station or a public safety harbour, the advantages of the South Bay of Wexford over any other point on the coast of Wexford are incomparable.

Captain RICHARDS, R.N., said they should not have troubled the Commissioner with the statement just read, only that, owing to the Secretary of the Harbour Commissioners being out of town when Captain Washington arrived there, there was not sufficient notice given of the then intended inquiry.

Captain DENIS KENSELAH principally agreed in the statement first read, but thinks that some money of the Commissioners would be well laid out in improving the harbour. [Captain K. then submitted a plan of his own for deepening Hantoon, which the Commissioner carefully examined; it appeared to accord with Captain Frazer's opinion on the subject.]

Mr. JAMES KENSELAH.—If this plan be carried out, they would soon have the South Bank a dry island.

Mr. GREENE.—Besides six, instead of three hours tide, as at present, would run over Hantoon, thereby keeping it clear of all deposits.

Mr. ALLEN.—Engineers should be consulted on the subject.

COMMISSIONER (to Captain Kenselah).—Is the pilot establishment sufficient, as set forth in the statement put in?

Captain KENSELAH.—Yes; if placed on another principle.

Captain FRAZER.—The pilots ought to be paid by the job, and not by salary.

Mr. JOHN HOWLIN.—To prove the truth of Captain Frazer's position, he (Mr. H.) could aver, that he was in the "Pearl" once under very precarious circumstances, and no pilot came to her.

COMMISSIONER (reading from the statement, and addressing himself to Mr. Allen).—Do you approve of a ship-canal in the harbour?

Mr. ALLEN.—Yes; Mr. Cubitt, Sir John M'Neill, and others pronounced on its feasibility.

COMMISSIONER.—But Mr. Rendell and Mr. Farrell (your County Surveyor), disagree with them.

Captain FRAZER said that he had some conversation on the subject with Sir John M'Neill, but that it appeared to him (Captain F.) that the great difficulty would be in the keeping open of a sea-lock for the proposed ship-canal.

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No. 34.

Account of Vessels Wrecked on the Coast of Wexford, for Seven Years past.

No. 34. Account of Wrecks.

Date.	Name, &c.	Value.	Lives lost.
1838		£	
Feb.	"Paragon," brig, from Liverpool to Pernambuco	30,000	6
,,	"Kingston," brig, Plymouth to Liverpool.	500	..
,,	"Orissa," schooner, Glasgow to Bristol	1,500	..
Nov.	"Water Witch," schooner, Glasgow to Leghorn	800	..
,,	"Ariadne," ship, Quebec to Belfast	4,000	8
1839			
Jan.	"Union," schooner, Chepstow to Wexford	1,000	..
May	"Elizabeth and Ahlia," galliot, Amsterdam to Liverpool . .	300	..
Sept.	"Feliz Pensamiento," brig, St Ubes to Sligo	400	..
,,	"Brunton Haliburton," ship . .	4,500	..
1840			
Jan.	"Eliza and Abby," ship, Wilmington to Liverpool.	3,000	..
,,	"Six Brothers," schooner, Cork to Newport	800	..
,,	"Francis," brig, Cork to Liverpool	1,500	4
Mar.	"Belina," brig, Quebec to North of Ireland	2,600	..
Oct.	"Theseus," ship, St. Johns, New Brunswick to Clyde . . .	8,000	..
1842			
Jan.	"Urania," ship, Malta to Liverpool	9,000	8
	Carried forward . . £	67,900	26
1842		£.	
	Brought forward . . .	67,900	26
Jan.	"Honor," schooner, Messina to Liverpool.	1,500	..
Dec.	"Vermont," ship, Savanna to Liverpool	16,000	..
1843			
Feb.	"Santon," barque, Calcutta to Liverpool	20,000	2
Nov.	"Rover," brig, Arklow to Swansea.	400	..
..	"Zeno," brig, Liverpool to Jamaica	30,000	..
Dec.	"Salvatore," brig, Liverpool to Naples	5,000	3
1844			
Jan.	"Minerva," barque, Glasgow to Bombay	9,000	..
Mar.	"Georgio," brig, Liverpool to Palermo	8,000	..
,,	"Georgina," barque, Liverpool to Africa	40,000*	11
Dec.	"Victory," sloop, Chepstow . .	150	..
,,	"James Mathieson," Liverpool to Hong Kong	40,000	..
1845			
Jan.	Royal Albert, ship, Liverpool to Ichaboe	6,000	..
,,	"Jager," ship, Liverpool to Calcutta	30,000	..
Feb.	"Burley," barque, Liverpool to Coast of Africa	2,500	..
	£	276,450	42

* Part of the cargo raised by divers produced upwards of 20,000*l.*

Dated at Wexford, 1st January, 1846,

(Signed) Francis Harper, *Agent for Lloyd's,*
And for Liverpool and Glasgow Underwriters.

(Copy Extract.)

No. 35.

No. 35. Rennie on the Improvement of the Harbour.

Sir John Rennie, C.E., *Suggestions for the Improvement of Wexford Harbour.*

Gentlemen, *London*, 31*st May*, 1831.

In consequence of your resolution of the 19th January, 1830, requesting me to examine the port of Wexford, in order to give my opinion as to the most advisable plan for improving it, I proceeded thither on the 3rd of October last (having previously sent Mr. Aird) to ascertain some of the leading facts, and examine the whole generally during spring tides, which were very favourable for the occasion; although, before I could venture to give a complete detailed opinion upon all the various points connected with it, a proper nautical chart of the whole harbour and adjoining headlands, shoals, and currents should be made.

I will now, however, proceed to describe generally the causes and remedies for the present evils, founded chiefly upon the information communicated to me on the spot, combined with my own observations, deferring the details until the requisite survey shall have been made.

The harbour of Wexford is formed by the confluence of the river Slaney and several other small streams which descend from the adjoining highlands, and discharge their waters into the Irish Channel, between the great headlands of Greenore on the south and Glascarig on the north; and from the peculiar situation of these headlands, which prevent the main strength of the offing tide from approaching the shore, an extensive bay is formed, and the whole space within is operated upon by the counter currents opposed to the main ones in the offing. These latter, assisted, moreover, by the prevalence of gales from the southward and eastward, obstruct the discharge of the river waters into the sea, and at their junction both are compelled to deposit the alluvial matter with which they are mutually charged from the interior and adjoining coasts, and are thus the cause of forming the extensive range of sand-hills which at present constitute the boundaries of the outer harbour: the space within consequently becomes an extensive lake, or receptacle for the inland and tidal waters which discharge themselves into the sea by the present entrance between the sand-hills, more or less effectually, according to prevalence of particular winds and floods; from the same cause, also, the principal or outer bar, at the entrance between the sand-hills, is formed, and has now increased to such an extent, that it becomes highly desirable to devise some plan for its improvement.

By referring to the history of the bar, as far back as the year 1808, it appears that it was then in the direction east and by south, and had 14 feet upon it at low water of spring tides, and it continued in this favourable state, easy of access and departure, for many years, until a succession of severe gales from the eastward closed it up and forced it gradually to the northward, until it had only about eight feet upon it at low water. This was subsequently closed up, and the present two entrances were opened to the southward, one close to the fort, and the other, or principal one, about one mile further outwards: upon this there is only 6·0 feet at low water of spring tides; and as the rise of tides at springs is only about six feet, and at neaps from three to four, even vessels of the smallest class (except fishing-boats) are compelled to wait outside the bar, exposed to the danger of shipwreck (which so frequently occurs on this dangerous coast) before there is a sufficient flow of tide to enable them to enter the harbour. The difficulty of entering and departing is still further increased by the opposition of the counter or bay currents to the main or offing currents, because from half flood to half ebb the current

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Rennie on the Improvement of the Harbour.

sets to the southward, and from half ebb to half flood it sets to the northward. So that when the tide is rising and falling in the offing, which is the most advantageous time for the entry and departure of vessels, the current is against them; and at times, during the prevalence of particular winds the current sets constantly to the southward, which renders the entrance still more precarious and difficult of access.

The navigation of the interior of the harbour, also, between the entrance and Wexford (a distance of five miles) is extremely defective, the channels being both circuitous and shallow. Upon leaving town, until reaching the shoal called Gull Bar, the channel is tolerably direct and regular, having from 12 to 13 feet at low water; but from thence it becomes extremely circuitous, bending almost at right angles to the former, and has little more than eight feet at low water until it reaches the Island Hole, from thence it sets strongly to southward upon the fort, having five to six fathoms at low water, which decreases rapidly to six feet upon approaching the bar, as above mentioned. This defective state of things is further increased by the position of the Coal Channel which enters at right angles to it, and consequently checks the operation of the current of the main channel both upon the ebb and flood, and forms another bar between them.

Such being the disadvantageous state of the harbour at present, it becomes a question of considerable importance to determine the most advisable plan for improving it; and here it may be observed, that the principal causes of the evils complained of arise, First, *from the defective or improper direction of the currents within and without the bar.* Secondly, *from the obstructed state of the channel between the town and the entrance*, and the general tendency to diminish the receptacle for tidal and flood waters. To obviate the first, the different channels, which now run counter to each other within *the entrance, should be collected together, and guided* so as to act in one and the same *direction*; and in order to prolong their effect beyond the entrance, the inner channel, which now runs close to the fort, should be gradually closed and diverted by means of some slight works extending level with or a little above low water, as shown on the accompanying sketch at A, which should be extended gradually outwards, in proportion as required. By this means, the whole force of the united currents, both upon the flood and ebb, would set directly outwards and inwards, and their whole effect would be prolonged so as to act with full force upon the outer bar, which would thus be removed into deeper water, similar to what it was in 1808, when the navigation was considered to be in the most flourishing state; and by being kept in this direction by the works above mentioned, it would not be so liable to be influenced by the prevailing winds as formerly.

Secondly, as the maintenance of the navigation and the keeping down of the bar depend mainly upon the quantity of water passing over it, Gull Bar and all the other shoals between Wexford and the entrance should be removed by dredging or other means, and confined to a proper width by light works extending about the level of the present mud banks; so that the receptacle for tidal water would not be diminished but rather increased, because the channels for receiving it, by being kept in better order, would receive, discharge, and disperse it over the extensive estuary within far more effectually than formerly. Care should be taken that no further embankments of the lands over which the tide is accustomed to flow should be permitted, without making compensation by an adequate excavation; on the contrary, care should be taken to increase either in width or depth the space for the reception of tidal water. The prejudicial operation of this was unfortunately too well exhibited in the embankment of 800 acres from the Coal Channel about 15 years ago; for I have very little doubt that the abstraction of the quantity of water occasioned by this, was one and not a trifling cause of the deterioration of the bar which began to take place about that time.

Such is the general outline of the plan which I would propose for the improvement of Wexford Harbour; which, if judicially and gradually pursued, co-operating with, but by no means opposing, the operations of nature, will, I have no doubt, be attended with the most beneficial consequences.

With regard to the expense, without having a correct chart, as above mentioned, I am not prepared to state, but I am convinced that it will be moderate, and such as will come within the means of such an enterprising and improving port as Wexford; and when I am in possession of the chart above mentioned which should be prepared as early as possible, I shall be fully prepared to detail my views more completely, preparatory to commencing the operations.

Before closing this report, I cannot help expressing my thanks for the various valuable information communicated to me by Mr. Hull, and the other gentlemen of the Custom-house department, and by Mr. Powell and the various pilots who accompanied me, which has materially abridged my labours, and assisted me in coming to a proper understanding upon this important subject.

I am, &c.,
JOHN RENNIE.

The Worshipful the Mayor and Corporation of Wexford,
&c. &c. &c.

No. 36.

M'Call on enclosing the Slobs, 1837.

No. 36.

Report on the Harbour and Coast of Wexford, from the Point of Greenore to Blackwater Head,

by ROBERT M'CALL, C. E.

IN accordance with the resolution of the Commissioners of Wexford Harbour, I have made an accurate survey and strict examination of the Harbour and Coast of Wexford, from the Point of Greenore to Blackwater Head, by which I am enabled to submit a Map of, and Report on, the same, for their attentive and judicious consideration.

The Harbour of Wexford is situate on the River Slaney, opposite the Town of Wexford, and 4½ miles from the sea, by the windings of the Channel; but that distance will be reduced to 2½ miles by the projected course. The course of the Fairway, from the Quay to Gull-Bar, is south-east and north-west; at Gull-Bar it forms a curve, and bears north-east and south-west, to the middle of the Great Island, where it forms another curve, and bears south-south-east and north-north-west to the Fort, where it disembogues itself into the South Bay of Wexford, south-west extremity of St. George's Channel, 16 miles north-north-west and south-south-east from Tuskar Rock, and 45 miles north-west from St. David's Head, South Wales. Therefore, it is the most eligible situation, as to distance from England, for the arrival and departure of the English mails, along the south-west coast of Ireland. Were the Mail Packets on this station, they would avoid all the foul grounds, and many contrary winds, which prevail in the present station, while the North and South Bays of Wexford assume the stillness of a pond, compared with the difficult and dangerous navigation from Tuskar Rock to Waterford. It will save 120 miles of steam navigation daily, and 4,985*l.* of annual expense. The British mail would arrive at Wexford at 6 o'clock in the morning, 29½ hours earlier than at present; at New Ross at half-past eight, and at Waterford at ten, on the present roads. The great saving of time and expense, which would result from this arrangement, forms a question of important consideration to the Right Hon. the Lords of the Treasury, and to the mercantile community throughout the south-west of Ireland.

Carne and Kilmore have been recommended for the Mail Packet Station; but there is neither protection nor are there local inducements to justify such an undertaking.

During the last twenty-three years the bar of Wexford has been a great interruption to the navigation of the harbour and general prosperity of the country. Since that time it has been gradually accumulating from natural causes; and if not prevented, will form a complete barrier even to the small class of vessels at present trading to and from Wexford.

Formerly the Burrow of Roslare and the Raven Point were covered with the *elymus arenarius* and various species of *juncis;* but these grasses began to decay, and the fine sand which composes these burrows to drift into the water, with the constant diminution of the Great Island, and the regular increase of the Broad Gut, which is all carried down by the currents and receding tides, and deposited in a state of solid aggregation, where the pressure of the river and the resistance of the sea form an equilibrium.

This is the true cause of the formation of the bar of Wexford, which is liable to shift with south-east winds; but by the adoption of the plan I have in contemplation, the bar of Wexford, with the Dry Dogger Bank and the Channel of Hantoon, will totally disappear. Consequently it would be imprudent to improve the present channel, which would be expensive, circuitous, and incomplete.

Gull Bar is another interruption to the navigation to Wexford; but from numerous borings to the depth of 20 feet, at low water of spring tides, which proved the non-existence of any impediment to the deepening of the channel to any purposed depth. It was very difficult to extract the augur from the tenacious nature of the various strata, which are composed of mud, 1; sand, 2; gravel, 3; black turf, 4; debris of shells, 5; blue marl, 6; yellow clay, 7. The perforation of the augur was prevented twice by timber. I do not know whether it is indigenous or part of a wreck.

A channel, 20 feet deep at low water of neap tides will be sufficient; for from Lloyd's List for 1833, there were only 33 vessels out of 10,430 which drew 20 feet water, 4 that drew 21 feet, and 1 drawing 23 feet water. Probably in four years there will not be a merchant ship in Britain drawing more than 18 feet water.

To perfect the navigation to Wexford, a channel must be cut past the end of the ship-building yard of Messrs. Archer and Leared across the Burrow of Roslare into the South Bay, a little to the east of the ham of the bay, and three miles west of the present entrance to Wexford, which is finely sheltered by the land. This will bring the harbour and South Sheared Channel in a line, which will be an excellent passage for all vessels bound south west or north-east. The South Sheared Channel is 1½ mile in width, between Holden's Bed and Cawmeen Bank. The North-east Sheared is three miles in width between the Burrow of Roslare and the Long Bank; after these two banks are passed, the vessels are in St. George's Channel. The depth of water in each channel is the same, and gradually decreasing from 150 to 20 feet within a few yards of the shore at low water.

This improvement in the navigation of this harbour may be accomplished in the most perfect order in a few months, without putting the corporation of Wexford to any more expense than they incur with the present dangerous bar; nor can there be any interruption to the navigation of Wexford in future, by the formation of bars or other impediments. Then vessels drawing 18 feet water may arrive at, and depart from Wexford at any hour by day or by night with twenty-six points of the compass, in perfect confidence and safety. Whereas from the 10th till the 16th of December last, six vessels were detained seven days by the low water on the bar:—

16th December,	7 vessels	5 days.
4th January,	7 do.	13 do.
16th February,	35 do.	36 do.
27th do.	7 do.	7 do.

These vessels contained 62,000 barrels of corn, and during the said time the price declined 3*s.* per barrel, and the loss sustained by the merchants of Wexford on this occasion amounted to 9,800*l*, exclusive of contingencies. At Wexford, in February last, the price of beans declined 7*s.* per barrel in the course of five days. During winter the public, and especially the poor, endured great privations from the unprecedented high price of fuel, while it could be purchased for 8*s.* per ton on the opposite coast. Is the whole country to suffer on account of the bar, and the selfish motives of the few?

Until this great improvement is effected, the trade of Wexford must decline; for no encouragement to industry or stimulus to enterprise will be given, while the entrance to Wexford remains in its present state, although it is admirably adapted to become the emporium of the south of Ireland, from the fertility of the country, its local situation, and its proximity to England and the Western Ocean.

In the event of the improvement of this harbour, it is but reasonable to expect a great increase of of the import duties, especially on the articles of tea, wine, sugar, and tobacco, amounting to fully 50,000*l.* per annum, for the supply of which Wexford depends on Liverpool, Glasgow, Dublin, and Waterford markets; whereas, if these essential articles were landed direct at Wexford, it would prevent trans-shipment, and be considerably cheaper to the consumers. Likewise nine thousand acres of valuable land will be reclaimed, and made available for agricultural purposes, and a fine level road could be made along the new channel from Roslare to-Wexford, which will be seven miles shorter than the present road, and would be very convenient for the inhabitants of the Barony of Forth and Wexford.

The achievement of this great desideratum will be of the highest advantage to Lloyd's; for this harbour is pre-eminently adapted as a haven of refuge to all vessels in St. George's Channel during contrary winds, foggy and stormy weather, when many fine ships are lost in it, there being no safe anchorage from the Cove of Cork to Dublin Bay, a distance of 219 miles. The recent loss of the ships "Sultana" and "Glasgow," in the vicinity of Wexford, is sufficient of itself to excite a spirit of inquiry, whether a haven of refuge might not be obtained on this coast. When the wind is unfair for proceeding up or down St. George's Channel, it will be fair to run into Wexford, which will be one of the finest outlets for vessels home or outward bound.

In the new channel, the tides will set straight in and out, over a solid marl bottom, where there has been no variation in the depth for the last forty years; whereas no other entrance could be obtained

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on this coast, without being intersected by cross tides. Therefore every thing is in favour of the new channel; and if the Corporation do not adopt it, they will neither consult their own interest, nor the benefit of the public.

Tides.—The flood tides in Saint George's Channel set in from the west out of the Atlantic Ocean, on a line with Tuskar Rock, and run from Tuskar through Saint George's Channel, north-east and south-west. It is high water at Wexford at 6 o'clock, full and change of the moon. The highest rise of spring tides on the bar of Wexford is six feet, and neap tides four feet. The rise and fall of the lowest neap tides is one foot six inches, when it is high water at Wexford at 10 o'clock. It is high water on the bar three hours before it is high water in St. George's Channel. Sometimes the tides have risen eight feet in the harbour of Wexford, which were caused by strong south winds, and the consequent extension of the water within the harbour.

Bar.—The bar of Wexford lies in the north-east of the south bay, and bears north-east and south-west, and the depths of water upon it are various. High water at spring tides 13 feet, high water at neap tides 11 feet; low water at neap tides seven feet; low water at spring tides five feet.

Banks.—The Dry Dogger Bank lies between the Channel of Hantoon and the south-west end of the bar. It bears north-east and south-west, and is dry from half-ebb to half-flood. It is remarkable that the mutations of this bank correspond with the shiftings of the bar; these changes are caused by south-east winds and the currents in the channel of Hantoon.

The Long bank lies in the centre of the south bay of Wexford, and bears north-north-east and south-south-west. It is thrown up in the eddy caused by the tides flowing west of Tuskar Rock, and the re-percussion of the Burrow of Roslare. It is only seven feet under low water of neap tides, and five feet under low water of spring tides. It is surprising that this bank is not laid down in any chart of St. George's Channel, and has neither buoy nor beacon placed upon it to warn the approaching mariner of his danger, although it is the most destructive to the shipping interest along the coast of Ireland.

The New Ground lies in the south bay of Wexford, and bears north-north-west and south-south-east from the bar of Wexford. It is 30 feet under low water of neap tides, and 28 feet at low water of spring tides. In the charts of St. George's Channel, this bank is laid down in three feet, instead of 28 and 30 feet.

Howlin's or Holden's Bed lies in the south bay of Wexford, north of Sheard Channel, and bears north-east and south-west. It is nine feet under low water of neap tides, and seven feet under low water at spring tides. The formation of this bank is caused by the tides flowing south-west of the point of Greenore.

Cawmeen Bank lies on the west of Sheard Channel in form of an arch, and it is dry at low water of spring tides. The formation of this bank is caused by the projecting point of Carrig Reef, which extends nearly one mile into the sea, and by the strong currents in Sheard Channel during the receding of the tides.

Blackwater Bank lies in the north bay of Wexford, and bears from the bar of Weaford east-north-east and west-south-west, distance nearly six miles. It bears south-east from Blackwater head, and distance five miles. There is placed at each end of this bank a buoy, which cannot be seen by night, and is the principal cause of the many losses of valuable property upon the shoal.

I recommend the erection of two pillar beacons on Blackwater Bank, also one on the north-east of the Long Bank, one on the south-west of Holden's Bed, and one on Carrig Reef. If these beacons are properly prepared and placed, they will endure 50 years without repairs, and their cost will not exceed the price of a common buoy.

It will be indispensable to erect two clear stationary lights on the Burrow of Roslare, one on each side of the new channel, which will be very cheap, being supplied from the gasometer in Wexford. By the adoption of this plan the loss of vessels along the south-west of St. George's Channel, will be very unfrequent in future. It will prevent the loss of much valuable property, the sacrifice of human life, destitute widows, and helpless orphans.

I have laid down the new channel, with a transverse section of the same, showing the rise and fall of the tides in Wexford harbour, present depths of the bar, and in the channel to the quay. I have stated everything carefully which fell under my observation; and those most interested in this grand and useful undertaking, I most respectfully recommend to consult my map, which will convey a clearer conception of the whole than any written detail could possibly do.

To conclude, I most respectfully recommend the harbour of Wexford to the Right Honourable the Lords of the Treasury as the Mail Packet Station. To Lloyd's and the shipping interest north of St. George's Channel, as a Haven of Refuge. To the Corporation and Merchants of Wexford as a Harbour of Trade and Commerce. It merits the immediate attention and support of all interested in the present and future prosperity of the county—for its capabilities and natural advantages only require to be made properly known to be made available. The want of it being a total loss of many thousand pounds annually to the merchants of Wexford.

Frequently vessels have been detained eight weeks in this harbour, and some ten weeks by the bar alone, and their cargoes had to be discharged, to prevent utter loss. The same expense and inconvenience attend the imports. It is an immense loss to Lloyd's and the shipping interest in general, and a complete prevention to the employment of a poor, redundant, but industrious population.

ROBERT M'CALL.

No. 37
Cubitt, on improving the Harbour, 1838.

No. 37.

Report of W. CUBITT, Esq., C.E., *on the Improvement of Wexford Harbour.*

SIR, *London, 28th Sept.* 1838.

I have now the honour to address to you this report, which, from previous engagements and unforeseen circumstances, I have found it impossible to do before this time.

Adverting to a correspondence between us in the early part of the present year, and with reference to yours of the 10th February, and mine of the 20th of that month, it will appear that after inquiry made as to the possibility and expense of my services, I undertook to "go to Wexford, make a careful inspection of the harbour in question, both outside and inside the low-water mark on the coast, Cubitt on improving the Harbour. 1838.

make requisite observations, and hearing all such evidence as could be obtained on the spot, to investigate Mr. M'Call's plans, return to London, and draw up a full report upon the subject," on terms therein mentioned.

In accordance, therefore, with the above engagement, I proceeded to Wexford about the middle of June, arriving there on the 15th of that month, and proceeded at once on that and the following days to make myself acquainted with the circumstances of Wexford Harbour, as applicable to the objects of my inquiry, and for assistance in which, next to your own valuable and unremitting exertions in procuring and giving me information, and in perambulating the coast and boundaries of the harbour, my acknowledgments are due to Mr. M'Call, for his attention to all my inquiries relative to his particular plan, both then and subsequently by letter, and also for promising me many reports, plans, returns, &c. relative to the state and trade of the port; to Mr. Powell, for his assistance and information, both then, as to the state and navigation of the channel and subsequently with regard to soundings, borings, &c.; to Mr. Finnellan, for the permission to examine a private chart of the harbour, constructed from his own observations; and also to Major Boyd, Mr. W. Allen, and other gentlemen, for their attention to my inquiries on various matters connected with the mudlands, the harbour, and the trade of the port of Wexford.

The principal or leading object referred to my attention being the plan suggested by Mr. M'Call, for making a new entrance to the harbour, stopping up the present entrance, and enclosing and draining all the slobs or mudlands which are uncovered at low water, amounting, in the whole (as he states), to 20,000 acres and upwards; a project altogether so vast and comprehensive, embracing so many details in its execution, and estimated at so little expense, compared with its magnitude and difficulties, and the whole set forth with so much apparent clearness, and just assurance of success, that I was more than ordinarily anxious to attain a clear notion of the "locale" in all its bearings, which I endeavoured to do by a perambulation of the sea-coast from Greenore Point to Blackwater Head, including Rosslare and Raven Points, at each side the entrance to the harbour; and also an examination of the whole coast of the harbour inside, from point to point, together with the navigable channels therein. I also took soundings below or outside low water mark at sea, from the proposed entrance of Mr. M'Call's new cut, in a line or bearing half way between Greenore Point, and the Tuskar Light, to ascertain the nature of the coast, and compared the whole carefully with Mr. M'Call's plans, in order to form an opinion as to how far the same were capable of being carried into effect; how far they might succeed if effected; and whether it would be expedient to entertain the project. And before proceeding to state my opinion on the question, it may be as well probably to describe, as briefly as possible, the present state of the harbour, and the plan proposed by Mr. M'Call for its improvement.

The harbour of Wexford is formed by a large, extensive estuary or slake of the river Slaney, just after it passes Wexford Bridge, and before it discharges itself into the sea, at a point on the east coast of Ireland, in the county of Wexford, about seven miles distant, northwards from the point of Greenore, and 12 from the Tuskar light from which it bears N. by W. (by compass). This entrance to the harbour of Wexford, or point of discharge of the river Slaney into the sea, is from one-fourth to one-third of a mile wide, and from five to seven fathoms deep, with a great extent of sand-hills, both to the northward and southward, which separate the sea from the extensive "slake" or harbour of Wexford inside.

The extent or length of this slake, north and south, or parallel with the coast, is about eight statute miles, and its greatest breadth, east and west, from Wexford Bridge to the "Fort" at the harbour's mouth, about four miles.

The beach and sand-banks, or (as they are locally called) "burrows," between the sea and the slake or harbour, extend about three miles each way, north and south of the harbour entrance, and vary from one-fourth to three-fourths of a mile in breadth, between high-water marks, inside and outside; but both sets of burrows are crossed by various gaps, through which the sea rolls at the top of very high tides.

The total quantity of land in Wexford Harbour covered by the sea at high water, is probably about 20,000 statute acres, more than one-half of which is probably uncovered at low water of spring tides, and much less than half, in my estimation, at the low-water neap tides.

The main channel of the river Slaney, after passing Wexford Bridge and the quays of the town, goes across the slake, or harbour, by a very crooked course (which forms the navigable channel), to the sea; first south from Wexford Bridge, past the quays one mile,—then south-east to the bend or turn at "Gull Bar" (a shoal), about another mile; then north-east for about a mile and a half, and thence south by east, or thereabouts, for upwards of two more miles to the "Fort" or point of discharge into the sea; being a distance of nearly six miles by the navigable channel, from the bridge at Wexford to the sea, which from point to point, in a direct line, is less than four miles.

Besides the main channel of the Slaney, there are several other channels or swashways crossing the slake or shines of the harbour, the longest and most remarkable of which is called the "Coal Channel," which lies at the back of, and almost parallel to, the burrows of Rosslare, and forming a junction with the main channel of the river just inside and opposite to the harbour entrance. This channel lies E. by N. and W. by S., and is remarkable for its great depth; besides this, there are various other channels, such as "Beg Erin," which enters the navigable channel at the bend below "Gull Bar," and others, as will be seen on reference to a reduced plan which accompanies this report, wherein the general plan of the harbour will be seen and understood more clearly than by any written description.

The average rise of spring tides in Wexford harbour is stated at four feet, although sometimes they are five and even six feet, depending on particular winds at the time of springs, which at other times and at neap tides, the rise is but about two feet, and sometimes, as I was given to understand, not more than 18 inches

At the period I was at Wexford, there was from 5½ to 6 feet water over the bar at low water of spring tides in the S.W. channel, which the pilots stated to be the best; so that with a good flow there would be about 11 feet over at high water, and this agreed very well with my own observations, as on one of the days (18th June) I was at the harbour entrance, the "Rover" steamer, drawing 10 feet water, went out freely over the bar at a quarter to 2 P.M.; therefore, from 8 to 11 feet over the bar may be taken as the depth of water at the entrance of Wexford Harbour.

The above is certainly a most unfavourable state of things for a harbour of such importance as this certainly is, and well deserves every consideration for its improvement; and the means by which Mr. M'Call proposes to effect his improvement are as follows, viz.:—

First.—To make a new cut 400 feet wide and 20 feet deep, embanked on both sides, from the

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quays at Wexford to the sea, in a line between the Tuskar Light and Greenore Point, being north and south (by compass) very nearly; and through this new cut or channel to turn the river Slaney, which would then be entirely cut off or insulated from the large tracts of mudlands or slake of Wexford Harbour.

Secondly.—To stop up the present entrance from the sea, and inclose and drain the slobs with a view to turning them into land, to the extent of from 15,000 to 20,000 acres.

Thirdly.—To form a road on the west side of the new cut, erect piers and light-houses at the entrance of the new channel, form a basin or "safety harbour" from part of the present Coal Channel; and

Fourthly.—To do all this at an outlay of less than 120,000*l.*

Mr. M'Call also states confidently that, if such plan were carried into effect, there would at all times be a deep channel from the sea to Wexford Bridge, that no bar would be formed at the mouth or entrance of the new harbour, and that Wexford harbour, which has now a shallow entrance from the sea, encumbered with shifting sands and shoals, and not admitting vessels drawing more than 10 feet of water, and frequently not that, would on his Plan become a deep entrance, unincumbered with any bar, and opening direct into the haven as a harbour of refuge at all times for vessels of a much larger class than can at present have access to the port; and, moreover, that the land to be gained by this improvement would more than compensate for the outlay to effect the whole measure.

That such are the views and expectations of Mr. M'Call, will be seen on perusal of some extracts from his reports and communications, which I have inserted by way of appendix at the end of this report.

Now, since I was at Wexford, I have thought much on this subject, and considered the proposed plan very carefully, and although I do not pronounce it to be impracticable to make the proposed cut or channel for the river Slaney, yet I have no hesitation in saying that it will, in my judgment, be impossible to carry such a plan into effect, at any cost that would be remunerative; and, moreover, I am of opinion, that were the river Slaney discharged into Greenore Bay, through a new channel, deprived of the immense extent of backwater contained in the present harbour, the possibility is, that not only would a bar form at and outside its entrance, but that the depth of water over the same would not be more than at this time over the present bar.

Again, with regard to reclaiming land, it appears to me that the greatest part of the slobs or slines which are covered and uncovered by the tides, lie too low to be effectually drained by sluices, even though the present entrance of the harbour and all the gape across the burrows north and south of it would be effectually stopped up; for whenever the low water of neap tides does not effectually run off, it would be useless to depend upon a natural or sluice drainage, as with a succession of sluggish neap tides and a wet season, the land would be swamped, and recourse had to steam draining which would not answer the purpose.

In stating the above, it must not be inferred that I conclude there is no part of the mudlands that could be reclaimed. On the contrary, I saw a great deal that might be enclosed by embankments, and reclaimed possibly with advantage as land, but certainly with doubtful effect as to the harbour, where there is so small a tide as at Wexford; because every cubic yard of water that is stopped off from the slines, it must be recollected, is prevented from running twice over the bar; and, therefore, to give the greatest latitude for reclaiming land, I should say that, in this case, not a single yard ought to be embanked off from the harbour which can be covered with the high water of a neap tide.

On the whole, then, as regards Mr. M'Call's plan, I think he is entirely mistaken in the three main objects:—1st. As to the difficulties to be encountered in attempting to carry it into effect. 2nd. As to the effects to be produced by it; and, 3rd. As to its cost. And, therefore, I cannot recommend the parties interested in the improvement of the port to entertain the project.

Having thus far disposed of that question, it may be asked, What, then, would you recommend to be done for the improvement of the harbour? And, in truth, it is a difficult question to answer—being well aware of the difficulties of making and maintaining a good entrance to a harbour situated in a flat, sandy coast, in front of an eddy tide, with not more than an average rise of four feet, or scarcely that. Under such circumstances, the difficulties of harbour-making are very great; and those difficulties are enhanced by the consideration that any plan must be esteemed as useless, the cost of which, together with its maintenance, would exceed the probable means available for its execution, and, consequently, expediency, rather than practicability, must be the test of any project for the improvement of this harbour.

From all the information I can obtain, it appears that the entrance to Wexford Harbour was much better many years ago than it is at present, and that its deterioration has been gradual, or very nearly so; and that in the last 30 or 40 years the depth has decreased from 12 or 13 feet deep at low water on the bar to six, or even less than that.

As it is evident that these effects cannot be without a cause, let us examine, as far as possible, what was the state of things inside and outside the harbour at that period.

From various old charts, &c., to which I had access, it appears that formerly the channel over the bar had a direction nearly east and west, with a large sand called the Dogger to the southward of the entrance; between which sand-bank and Rosslare Burrows was a narrow swashway, called the Hantoon Channel; and that withinside the harbour entrance, the main channel, or sailing course of the river, from the Fort to the Quays of Wexford, was much more direct than at present—which latter circumstance alone had a considerable tendency to produce a better bar, by acting more at right angles upon the Raven Spit, and cutting through that at the narrowest part, which, being extended, forms now a much worse bar than formerly.

Now it appears to me, that if the course of the river, after passing Wexford Quays, could be trained into the Coal Channel towards the port, instead of taking the crooked back-again channel over Gull Bar, and the channel of the river stopped across from the inner side of the Raven Point to the Mussel Bank Point opposite the Fort, both the harbour channel inside and the channel over the bar outside, would very much improve; inasmuch as the tendency of both the flood and ebb streams into and out of the harbour would be to take the best direction.

Cutting a channel across the river, from the Quays into the Coal Channel, without stopping afterwards the present channel, would effect no good and permanent improvement, because the river would still take its present course on the flood and partially on the ebb; thus leaving the new cut to silt up again, and not producing the right "set" or direction of the flood and the ebb streams over the bar; and in stopping up the present channel, the object must be to stop it across as low down or near the harbour's mouth as possible, in order that the whole of the water in the north and east, or Beg Erin side

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of the harbour, may be made to pass both up and down the new channel; and, consequently, the direction of the tides through the Gull Bar Channel would be exactly reversed from what they are at present.

I have no doubt that if a cut or channel could be formed of sufficient size, in a direct line from the first bend below the Quays to the entrance of the harbour at the Fort, and the present channel stopped as above stated, the best possible effects would ensue with regard to the bar and the entrance of the harbour; and so continue and keep improving as long as such channel remained in its right position, and all, or nearly all, the waters of both the harbour and the River Slaney made to pass up and down the new channel, which would have a direction to produce the best possible effect on the bar at the ebb tide, and a similar good effect (from having the indraught in the right position upon the flood).

In order to show this more clearly, I have made a sketch (see No. 2 of the accompanying plans), in which the proposed new channel, and the stop-dam of the present channel, are tinted red, and the Raven Point, Dugger Bank Bar, and Hantoon Channel, are laid down in the form and with the depth of water that, in my judgment, would obtain, if a direct main channel for the waters of the harbour and the River Slaney were made and maintained from the town of Wexford to the sea, at the present entrance by the Fort of Rosslare.

To carry the above plan into effect would involve an outlay of probably 100,000*l.* or upwards; but short of that I have no plan to recommend other than dredging out the Gull Bar Channel and removing the shoals there to a depth of 10 feet below low water, so that there should be that depth at least in all parts between the town and the Fort. This, and well marking and buoying the channel, would of itself be a great improvement, and might be carried into effect at a comparatively small expense; for with a present outlay of 5,000*l.* or 6,000*l.*, for a steam dredging-machine, barges, and implements, and 1,000*l* per annum, or thereabouts, for the next three or four years, the object would be effected; and 400*l.* or 500*l.* per annum after that would maintain the channel so improved. Besides which, the channel thus improved would have some effect upon the bar; inasmuch as the river above Wexford, as well as the water off the slines, would have a more free and unobstructed passage to the sea. Still that would be far short of the effect to be produced by a direct channel acting on the bar with the combined force of all the waters both of the river and the harbour.

When at Wexford I heard much of the disinclination of the merchants and shipowners of the place for the improvement of the port, on the ground that if the channels were made deep, and the bar permanently improved, it would destroy a monopoly supposed to exist in the possession of a large fleet of vessels of small draught of water, well suited to the port, by which they retain the business in their own hands, and keep coals and other articles during the winter at a very high price.

Now this appeared to me rather extraordinary as a reason for the expenditure of a very large sum of money to improve the harbour, when it is evident that the larger the sum expended, the heavier must be the dues and charges upon all ships and goods entering and leaving the harbour, to defray its cost.

It strikes me that a shipping or mercantile monopoly would be best met by competition, and the judicious employment of some capital in the building and working a fleet of steamers, or sailing vessels, or both, of a class and draught of water best suited to the harbour; for I have no hesitation in saying that three times the quantity of trade now done in Wexford might be done by vessels (steamers or others) not drawing more than eight feet of water, and then if, by means of a fair trading competition, and the employment of capital, trade increased, so as to require more accommodation by means of an improved harbour, improving the harbour would not only be a legitimate and praiseworthy object, but there would be the means to do it with—viz., a trade that would yield the tolls and dues to make the improvement. For it must always be borne in mind that, whatever sums of money it may cost to carry any plan of improvement into effect, the trade of the port must always be considered as sufficient not only to maintain and uphold the works, and pay all charges of management, and the interest of the capital sum expended in carrying such improved plan into effect, at whatever rate of interest it might be borrowed, but also at least 1½ or 2 per cent. upon the capital, in addition, with a view to being able to pay off the debt one time or other. Thus, supposing, for example, that it would require an immediate outlay of 100,000*l.* to carry into effect any plan for the improvement of Wexford Harbour—suppose, also, that wear, tear, and management would afterwards amount to 2,000*l.* per annum only; that the money would be borrowed at four per cent.; that 3½ per cent. would be the most that could be made by investment in the public funds, and that it would be necessary to redeem the debt within 50 years. In this case, the sum to be derived from the trade of the port must be,—

For wear and tear, management, &c.	£2,000
Interest of debt at four per cent.	4,000
Investment annually at 3½ per cent. to increase to 100,000*l.* in 44 years .	1,000
	£7,000

Which shows that there must be an income of at least 7,000*l.* per annum to justify an expenditure of 100,000*l.* towards the improvement of the harbour; and that under circumstances as to interest, &c., which it would perhaps be difficult to realise, as the time I have assumed for paying off the debt is very distant. The safest way would be to take the investment of the surplus at three per cent., and the time for its accumulating to the capital amount of 100,000*l.* at 30 years; to accomplish which, the annual investment must be 2,000*l.*, which would bring the annual income necessary to expend 100,000*l.* upon, to 8,000*l.*; to expend 150,000*l.*, to 12,000*l.*; 200,000*l.* to 16,000*l.*, and so on. Or, in other words, whatever sum it may be necessary to borrow to improve the harbour, there must be six per cent. per annum provided to enable it to be paid off within 30 years, with four per cent. for interest on the loan, exclusive of all charges for management and maintenance of the works.

Admitting, therefore, that the increase of trade from the improved harbour, after the works be completed, might stand as a set-off against management, &c., the most that could be taken up and expended upon this harbour would be about 16½ times its present annual income, without any increase of dues upon the shipping and trade of the port; or 16½ times any increased income arising from additional dues or otherwise, over and above the annual management and maintenance of the works.

I have, &c.,

W. CUBITT.

To Arthur Meadows, Esq.

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No. 38.

Mr. JACK *on the Improvement of the Harbour of Wexford.*

Wexford, 12th November, 1838.

GENTLEMEN,

In compliance with your letter of the 17th October, requesting me to visit Wexford at my earliest convenience, for the purpose of inspecting the coast and harbour, and drawing up a report on the same, previous to my return to Scotland, I left Bartonholm on the 1st November, and arrived here on the 4th instant, when I immediately proceeded to investigate this important question. Previous to the statement of my own observations, it may neither be improper nor unseasonable to make a few brief remarks on the respective plans which have been proposed by various persons for the improvement of Wexford Bar and Harbour.

I understand a Mr. Powell was one of the first persons who directed his attention to this object, and proposed to remedy the evil consequences of this dangerous and exclusive bar. The plan he suggested, was to make a new entrance to the harbour through the Windysheard, which is situated nearly one mile south-west from the present entrance. Had this plan been accomplished, it would have been a complete failure; because the situation is exposed to the same causes which form the present bar, with the additional evil of the Long Bank intersecting the line of this proposed entrance.

A Mr. Willis endeavoured to call public attention to a plan which he conceived would remedy the evil in question; but had it been carried into execution, the result would have been similar to the plan proposed by Mr. Powell.

In 1831 Sir John Rennie hastily inspected the harbour, and recommended the passage over the Bar to be contracted, in the expectation that the Bar would, by this means, be reduced. The accomplishment of this plan would suit the purpose, but the prodigious expense attendant would prevent its execution. Sir John adds, "Were I to make an accurate and careful survey of the coast and harbour, I might probably be disposed to recommend a superior plan for improvement."

A Mr. Gibbons proposed to make a new channel through the slines to Rathdowney, passing the south-west of the White House of Rosslare, and disemboguing into the ham of the South Bay. This plan is pre-eminently absurd, because its accomplishment would make the course even more curved than the present channel, and make it four miles longer. By disemboguing into the ham of the South Bay, it would, in all probability, form a bar, in consequence of the water being perfectly still, and out of the race of the tides; besides the expense of executing this plan would be immense.

It has been proposed to make a safety harbour in Ballygeary Bay, and a mail-packet harbour at Carne, extending from Wilken Rock to the shore. Were either of these plans accomplished, vast expense and a complete failure would be the consequence; because they would intersect the race of the tides, and the immense quantities of marl and sand conveyed by the receding tides would very soon silt them up; besides, Carne possesses neither protection from the storms, nor any local inducements, to justify such an undertaking. To complete a line of railway from Carne to Wexford, at the average computation, would cost 182,000*l*. Yet the British mail would arrive earlier at Wexford by the packet direct to the quay, than *viâ* Carne and the railway.

In March, 1837, Mr. M'Call was employed by the Corporation to make a survey of the coast and harbour of Wexford, extending from the Point of Greenore to Blackwater Head; and, if possible, to devise some plan for improvement. Mr. M'Call accomplished this survey, and the consequence was great dissatisfaction to the merchants of this port. It, however, excited considerable interest among the gentlemen of the county, who, much to their honour, subscribed a sum to pay another engineer to inspect the harbour, in the hope of obtaining a concurrence of professional opinion, previous to any material expense being incurred.

Mr. Cubitt was recommended and appointed for this purpose, and high expectations were anticipated from his report. It appears evident, from careful investigation, that Sir John Rennie, Messrs. Powell, Willis, Gibbons, and Cubitt, were ignorant of the true state of the coast and harbour of Wexford, and of the causes of the formation of the bar; otherwise they could not have recommended plans for improvement which would have been totally ineffectual.

Having concluded these brief observations, my duty is now to state the result of my own inspection, and to judge from the various circumstances of the case, being the true means by which to arrive at an accurate conclusion. I trust to your indulgence if I infringe upon your time, and most respectfully assure you that a question of such magnitude and utility richly merits your utmost patience and perseverance.

The first object that presents itself is the bar, which intersects the entrance to the harbour. It extends nearly one mile and a half from the Fort of Rosslare. In form it resembles a ridge, and bears north-east and south-west. Any endeavour to reduce or improve this Bar would be injudicious, because it is gradually increasing by causes over which man has no control. These causes are cross-tides and half-tides, shifting and drifting sands, all concentrating in a situation exposed to every wind. Were it even possible to effect any improvement, the passage to the harbour would still remain one of the most awkward and inconvenient that could possibly be conceived, in consequence of there being five courses and four curvations within the space of nine miles and a half. It is remarkable that the same causes which promote this bar, extend around the coast, with the exception of the very spot assigned by Mr. M'Call, as being the only place by which this harbour can be completely improved. Such is the gradual increase of the Bar, that if some effectual remedy be not soon adopted, the trade of Wexford will be totally extinguished. I understand it has increased in height, within these twenty months, no less than two feet, and that the Channel of Hantoon is now closed; and within the last month the dry Dogger Bank has totally disappeared. This gradual increase of the Bar, and constant mutations of these banks, were noticed by Mr. M'Call two years ago; and daily experience proves the accuracy of his observations. Under this conviction, Mr. M'Call continued his inspection of the coast until he arrived at the following accurate conclusion. And thus he devised an effectual plan of improvement, because it is laid down on the pure principles of that department of hydrodynamics which treats of the pressure of fluids.

"To perfect the navigation to Wexford, a channel must be made close to the patent slip, across the slines, Coal Channel, and Burrow of Rosslare, into the South Bay, on a line with the straight and regular race of the tides." . . . . "The bottom of the South Bay is composed of marl, and no deposit ever accumulates upon a marl bottom exposed to straight currents, consequently no such accumulation has ever taken place in the South Bay, on a line with the proposed channel, although millions of tons of marl and sand are annually conveyed into it by the agency of the tides; and though only one-half of the tidal water in the harbour flows into it by a channel consisting of

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five courses and four curvations, within a distance of nine miles and a half in length." . . . . .
"Besides, deposits never lodge in any of the channels which convey the tidal waters off the slimes; but, on the contrary, they are gradually growing deeper, though they lie in oblique and opposite courses, and some of them are from twenty to twenty-six feet in depth. It is therefore impossible for a bar to form at or outside its entrance, in the absence of every cause that has a tendency to promote its formation."

These arguments are perfectly incontrovertible, and this plan for improving the harbour will be supported by the affirmation of every practical engineer, possessing a thorough knowledge of his profession. Because no bar or other interruption can ever form where there is no resisting influence to impede the free and straight passage of the waters.

Great importance has been attached to the small quantity of the shelving sand overlaying the marl on the side of the South Bay, on a line with the proposed entrance, extending into deep water. This is no obstacle whatever, and ought not to be mentioned as such; for, suppose it were necessary to remove it, the same means will effect it that will be employed to make the new entrance.

There are minor circumstances connected with this important improvement that have not been mentioned, although well worthy of observation. I understand it has been proved in the most accurate manner, that the regular rise of the tides, on a line with the proposed entrance, is from seven to eight feet; in that case it will be from three to four feet higher than the regular rise of the tides inside the harbour. The bar, and situation of the present entrance to the harbour, is the sole cause of this great difference. A cross tide intersects the present entrance, which sets the stream to the north-east, and at the same time the bar prevents the full quantity of tidal water flowing into and out of the harbour.

The regular rise of the tides, on a line with the proposed entrance, will be from seven to eight feet, and, consequently, from three to four feet higher in the harbour * than it has risen heretofore, under ordinary circumstance, and from two to three feet higher at the bridge of Enniscorthy; which would be of great importance to the mercantile community of that town. This is a circumstance of primary importance to the proprietors of the slimes within the harbour, because the low water will be from three to four feet below the level of the slimes; consequently they will be kept perfectly dry, without having recourse to drainage of any kind.

By the proposed entrance there will be high water in Wexford Harbour one hour and twenty minutes earlier than by the present entrance; and at Enniscorthy in the same proportion of time.

I understand Captain Beaufort, who is Hydrographer to the Admiralty, paid considerable attention to this important question, and he stated his opinion of its merits in a letter to the Secretary. If this distinguished Hydrographer had surveyed the harbour a hundred times, he could not have arrived at a more accurate conclusion.

Desultory Observations.

The waters in the South Bay and in the River Slaney are pure and free from deposit.

The immense quantities of sand which is conveyed into the South Bay will be prevented in future, because the proposed entrance will prevent the cause.

The cross tides at present in the South Bay will become straight in future, in consequence of the proposed entrance being on a line with the straight race or sets of the tides. *Vide* the red and black arrows on the map.

The banks in the South Bay will be thrown upon the south side of the Burrow of Rosslare by this change of the indrought into the harbour.

The earth excavated out of the new entrance will be sufficient to embank the slimes on both sides.

One hundred and fifty feet must be taken off the end of the patent slip, because in its present position it will interrupt the line of the proposed channel. This would be a great improvement to the slip, and would prevent much labour in taking up the vessels, because of the deep water close to the side.

The Ballast Bank must be removed.

The Quay ought to be re-built, on a line from the bridge to the slip, and the Crescent filled up.

The catchwater drains must be made to convey the land streams off the slimes into the harbour; one to commence at Curracloe, the other at Rathdowoey Pill.

Connected with this great improvement, the pilots ought to be supplied with fine smacks of sixty tons each, to enable them to ply between Hookhead and Arklow, to prevent ships falling in with the banks. The Trinity House, in London, and the merchants of Liverpool, will lend their co-operation to this effect.

The plan for completing the navigation to Wexford is of itself comparatively small; but when the situation is taken into consideration, and the stupendous consequences which will result, must make it, perhaps, by far the most useful improvement ever effected in this country.

In a short time after the proposed improvement is effected, the narrowest part of the Burrow of Rosslare will become the broadest, because the cross tides will become straight and regular when the present entrance is closed, in consequence of the repercussion of the cross tides being removed, and which is in the ratio of their respective situations. Hence all the banks and sand in the South Bay will be thrown upon the south-east side of the Burrow, from whence the agency of the tides carried it away. Thus the bottom of the South Bay will become valuable oyster beds, and the River Slaney for salmon fishings, because oysters prefer clean marl, and salmon to run in the deep water.

I cannot conclude without most respectfully and urgently advising this committee to publish, without delay, a full statement of Mr. M'Call's Report and Map of the harbour and coast; then to use the most active measures to accomplish this great improvement.

You have a fine example before you to stimulate your industry. The erection of Tuskar Light was proposed for twenty years, but was not accomplished until the general voice of humanity demanded

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[*] This part of my Report excited fears for the submersion of the town by the flowing of the tidal waters over the quay, and up the common sewers. These overflowings of the tidal waters are caused by south-east winds, and the extension of the water within the harbour. This extension of the tidal waters will be prevented by the proposed improvement. Then the tides in the harbour will not be influenced by the winds, and the race of the tides will flow and recede on a straight line. Suppose the tides to rise to a definite height, after the proposed improvement is effected, all that will be necessary to prevent the overflowing of the tidal water will be to heighten the quay, and place a small culvert in each of the sewers, consequently not a drop of tidal water will ever effect the town.

One gentleman was afraid the bridge would be swept away by the tides. Were this to occur, it would be the most fortunate circumstance that ever was connected with it to the public in general and the shareholders in particular.

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it; and every one of you are, no doubt, aware that it has been the means of saving thousands of human lives from destruction, and an incalculable amount of property. Therefore it is most advisable that you lose no time in imitating such a noble example.

To the Gentlemen of the Committee,
&c. &c.

GEORGE JACK.

No. 39.

CAPTAIN VETCH, R.E., *on the advantage of Enclosing Mudlands in Wexford Harbour.*

Birmingham, 1st *December*, 1840.

No. 39.
Vetch on enclosing Wexford Slobs.

GENTLEMEN,

In attention to your letter of the 21st October, whereby you request me to proceed to inspect and report on the feasibility and advantage of reclaiming and improving certain Mudlands situated below high-water mark of ordinary tides, in the county of Wexford, I have now to inform you that, in the end of October and beginning of November, I made an inspection of the following localities, along with Mr. Dunlop:—

1. The entire Bay of Wexford below the Bridge.
2. The Lake of Lady Island.
3. The Lake of Tacumshin.
4. The Lake of Bannow.
5. The Mudland of Dumbrody.

Besides obtaining what verbal information could be procured in the course of my inspection, and perusing such printed documents as bore on the subject, I have had most essential assistance, in being permitted by Lieut.-Colonel Colby, R.E., and Captain Larcom, R.E., to see the documents in possession of the Government Survey, at the depôt in Phœnix Park, Dublin, and by being favoured with tracings from the plans of the above localities.

You are aware that the time allotted for my inspection did not permit of any new survey or levellings; and that, consequently, in forming my judgment, I have been obliged to arrive at results which are only approximations, in some respects, to accuracy; as, however, the high and low water marks presented good guides for the levels, I feel confident that they will not be far from the truth.

I now proceed to report on the several localities in their order.

Wexford Harbour is an inlet of the sea, situated near the south-east angle of the island, on the east coast, and with the entrance in that direction.

The form of this small gulf is oblong, with its length (eight miles), nearly north and south, and parallel to the coast, while the greatest breadth from the entrance at Roslare Point to the Slip Dock at Wexford, is only three and a half miles, and the average width is under two miles.

The outer or main harbour may be considered as terminating at Wexford Bridge, where the inlet is much contracted, but it again expands, and forms an inner harbour, extending to Carrick Bridge, with an average length of two miles by one in breadth.

Above Carrick Bridge, the River Slaney is navigable twelve and a half miles to Enniscorthy, with an average width of one-tenth of a mile, and subject to the tides, as far as the last-mentioned place.

The following is an accurate statement of the extent of surface of high water, under the several heads just enumerated:—

Outer or Main Harbour	11,858	English statute acres.
Inner or Back Harbour	1,362	do.
River Slaney from the Bridge of Carrick to the Bridge of Enniscorthy	1,050	do.
Total	14,270	
In the Outer Harbour the surface of *low water*, at spring tides, occupies an extent of about.	2,381	do.
That of the Inner Harbour	454	do.
That of the River Slaney	814	do.
Total	3,649	do.
Leaving uncovered at low water	10,621	do.

Of this last quantity, about one-half may be reclaimed with every prospect of advantage; but the remainder lies too low for effectual and economical drainage.

Tides.—The average rise and fall is stated to be as follows:

At the Tuskar Rock	Spring . . .	8 feet . . .	Neap	6 feet.
On Wexford Bar	do. . . .	6 do. . . .	do.	4 do.
In Wexford Harbour, generally . .	do. . . .	4 do. . . .	do.	2 do.
At Enniscorthy.	do. . . .	2 do. . . .	do.	1 do.

It might be expected where the tides are so small, that winds blowing into the harbour would produce a great comparative effect; and such proves to be the case, as storms from the south-east are known to raise the flood-tide to a greater height than what is produced by the phase of the moon; and a tide of six feet sometimes thus occurs in Wexford Harbour.

Shores.—The eastern shore of the outer or main harbour is nearly parallel to, and at a short distance from, the sea-beach, from which it is separated, in a great extent, by a range of sand-hills or burrows; these last form a long narrow barrier between the sea and the bay, and present an important feature in the boundary of Wexford Harbour, as well as in those of the other sea lakes, on which I have been called to report.

These narrow strips of sand-hills or burrows are formed by the action of the winds and waves, and are in a constant state of formation and re-formation. Occasionally a heavy storm forms breaches through them in their weak points, and these get closed again by the winds; but it was evident to me that the action of formation was much more powerful than that of destruction, and that it only required attention in propagating the usual sand plants to preserve the burrows secure from any destructive action of the sea.

In Wexford Harbour I did not observe any breaches in the burrows south of the entrance, and only three very insignificant ones north of it, which might have been stopped successfully at a comparatively trifling cost.

Vetch on enclosing Wexford Slobs.

The shores of the harbour on the south-east, and generally on the land side, are chiefly formed of low cliffs or banks of clay; and wherever this yielding substance occurred, forming the shore of this and the other sea lakes, I had strong evidence that it was under a process of destruction, and that this action had been long and effectively at work; and I am, therefore, obliged to conclude that the Inlet of Wexford Harbour has been gradually extending its boundaries at the expense of the land, the retiring floods carrying the debris to sea, where the mud is deposited in deep and still bottoms, and the sands cast back on the shores, where they form burrows and bars.

There are some parts of the west shores of the harbour composed of quartz, rock, and limestone, which effectually secure the land as far as they extend.

Entrance or Mouth of the Harbour.—This, at low water, is only 645 yards' wide; but it is six and a half fathoms deep; at high water the width is about double; the entrance faces the east; and is opposite to the quays of Wexford.

Channels.—The length of the main channel is as follows:—

From the entrance to Wexford Bridge	4⅔	statute miles.
From Wexford Bridge to Carrick Bridge	3⅓	do.
From Carrick Bridge to Enniscorthy	12⅓	do.
		do
Total	20⅓	

The main channel varies in depth, from the entrance to Wexford Bridge, from three fathoms to two and two and a half; but on the Gull Bar it is only one and a half fathoms at low water; it also varies in width in the above distance, from half a mile to a mile, but contracting at the Slip Dock at Wexford to less than 200 yards.

In the inner harbour one-third of the expanse is occupied by the channel; and above Carrick Bridge four-fifths of the bed of the Slaney is so occupied.

Besides the main channel, there occurs the coal channel, branching off at the entrance, and running southwards to a distance of five and a quarter miles, with an average width of 350 yards, and an average depth of 17 feet. This channel receives only a few small streams, so that its length, breadth, and depth, appear of a magnitude quite disproportionate to any apparent cause.

The only other channel requiring notice is that of the Beggarin, running through the north wing of the harbour; this channel is only six feet deep at low water, and its length and breadth are of small account.

I have been more particular in describing the harbour than the mere question of embanking some mudlands would seem to require; but as such embankments might he supposed to produce certain effects upon the navigation of the port, I feel myself called upon to investigate not only what lands might be enclosed with benefit to the adventurers, but to what extent, and in what form, the embankments might be made, without injury to the navigation, and with every consideration to its improvement.

I have refrained from all questions about altering the entrance of the harbour, or interfering with the main channel; nor have I ventured to form any opinion in respect to any alterations outside of the harbour, fearing that the most able engineer could hardly predicate what would be the effect of any interference with the natural causes now at work there.

Having stated most of the circumstances connected with the interior of the harbour, I now proceed to the question of the effect of diminishing its expanse upon the quantity and effective force of the tide water.

We may admit the principle that every yard of the interior expanse receives and returns a certain quantity of water constantly; and, consequently, the larger the expanse, the greater the quantity of tide water flowing out and in at the entrance; and, secondly, that the tides being of small amount in altitude, the greater the necessity of superficies to make up for the defect; but if we consider this question a little further, we will perceive that the principle is limited by circumstances; for if we suppose the mouth or orifice of the inlet to remain the same, while we expand the interior space *ad libitum*, we shall soon arrive at an extent, where the shores most distant from the entrance would remain always at half tide; and that though it might be desirable to compensate, if possible, for the defect of the altitude of the tides by a greater superficies, the endeavour would only be useful to a certain extent, beyond which it would become injurious.

The amount of useful expanse of the inlet is also limited by its form; for if it be oblong in the direction of the entering and retiring tide, it would admit of a larger useful surface than if it were oblong (as the harbour of Wexford is), in an opposite direction, since the direction and momentum of the tides would tend to fill and empty the space more rapidly in the first case than in the second. It is well known in funnel-shaped bays, that the momentum of the tide is not confined to produce a uniform level of high water; but that the altitude is much augmented at the heads of such inlets, as, for instance, in the Frith of Forth, the Bristol Channel, and many other localities; from which we may infer that the nearer an inlet approaches to a long funnel shape, the greater the tides; and the more it recedes from that shape, the less the tides.

In respect to Wexford Harbour, it will be perceived that besides the main channel on which the ports of Wexford and Enniscorthy are situated, there are two wings extending north and south, which have the effect of withdrawing large quantities of water from the main channel, and destroying the momentum of the tide in that direction, and exactly opposed to the circumstances which contribute the greatest flow of water; and the effect seems to be, that inside the harbour the tide is diminished by one-fourth to one-third of its altitude, and is retarded by one-fourth to one-third in time; from which I conclude that the superficial extent of Wexford Harbour already exceeds the maximum of utility, and ought to be diminished; that its figure or form is of the worst description, and would be improved by cutting off portions from the north and south wings of the inlet. On the other hand, I conclude that every facility and assistance should be given to direct the tides up the main channel, past the quays of Wexford, through the inner harbour, and up the course of the Slaney to Enniscorthy; and that not one yard of tide land should be embanked near to or above Wexford Bridge; that the Slip Dock,

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the Ballast Wharf, and the solid piers of Wexford Bridge, are highly prejudicial to the useful action of the tides, and that they ought to be removed; and with these various alterations I should expect to find the tide at Carrick Bridge approximate, in time and altitude, to that at the entrance of the harbour; and in this manner, though the expanse of the inlet would be diminished, the quantity of back water would be increased in energy, and not much diminished in quantity.

Having come to the above conclusions, I have no hesitation in selecting spaces from the north and south wings of the harbour suitable for embankment, and, in doing so, I have endeavoured to combine the most productive spots to be reclaimed, the most economical lines of embankments for execution, and, at the same time, to give a form and size to the outer harbour most suitable to the principles above stated.

North Embankment.

This line is 3,124 yards in length, and encloses 2,192 English statute acres. I have taken advantage of several islands, lying nearly in the desired direction, which diminish the length by 1,466 yards, while they offer many conveniences and good material for forming the earthwork of the embankment.

South Embankment.

Here I propose to make use of an old embankment in ruins, but of which much of the materials still remain, and which extends to a distance of 3,180 yards in the required direction; the remainder of the embankment (entirely new) will be 2,685 yards long, and cut across the Coal Channel. These two lines united inclose 3,341 English statute acres.

I propose to construct two double culverts in the North Embankment, six feet wide each, with two sets of sluices, one self-acting, and the other to be used as necessity may require, affording a clear waterway 24 feet wide; the sills of the sluices to be placed on a level with low water of the lowest spring-tides.

In the South Embankment I propose to construct three such double culverts and sluices, and I think it highly probable that it will be found expedient to provide a 20-horse pumping steam-engine for the Southern Embankment, and one of 12-horse power for the northern one, to aid the drainage in time of neap-tides. Besides the works just mentioned, means must be taken to divert as many of the small streams as possible from entering the enclosed spaces.

The total number of acres enclosed by the South Embankment being 3,341, but 233 being occupied by deep water, 3,108 acres remain available for tillage.

James Vetch.

No. 40.

Capt. Vetch, R.E., *on the advantage of Enclosing certain Lakes in the County of Wexford.*

Lady Island Lake

1st *December*, 1840.

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Vetch on enclosing Wexford Lakes.

Is situated on the south coast of the county of Wexford, and near the south-east angle of it. The extreme length of this lake, in a north and south direction, is two miles and one-third, and its extreme breadth, in an east and west direction, is one mile and one-third. The shores are low, and on the east side rocky, a considerable part of which consists of granite. The entire surface of the lake, at high water, amounts to 865 English statute acres, whereof about 250 consist of deep water, which, I fear, could not be advantageously drained, and therefore leaving only 615 acres available for tillage, after shutting off the tide waters. The south shore of this lake is about a mile long, running parallel to the sea-beach, from which it is separated by a narrow strip of sand-hills, or burrows, which protect the lake from the inroads of the sea, which breaks on this part of the coast with a heavy surf in south-westerly gales, more particularly in the winter season; one of the effects of which is, that in the beginning of winter the entrance to the lake gets completely sanded up, and the action of the tide is cut off until the spring, when a new exit is annually cut by manual labour, which remains open by the action of the tides until the next winter. When I visited it, in November, 1840, it was still open; but I was informed by the coast-guard that, in 1839, the entrance was closed by a storm in the month of September, and was not re-opened until the month of March, 1840, and until the water inside had accumulated so much as to begin to invade the adjoining fields.

It is obvious, in the case of this lake, that no artificial embankment is required, and that it would only be necessary to be careful in planting and maintaining the usual sand plants on the burrows, to shut out the tides, &c.

The difficulty in reclaiming the land of this lake is, to contrive an opening for the exit of the water, which would be able to stand the force of the breakers; and as the whole extent of the burrow and the strand on which it is situated consists of loose *sand*, the attempt could not be made there with any chance of success. The nearest spot I could observe along the shore which did not consist of loose sand, occurred about 1,000 yards west of the lake, and within 500 yards of the Lake of Tacumshin; at that spot the sea-shore, for about 300 yards, consists of a tenacious clay, exhibiting banks or low cliffs of that material, and I have no doubt that a good foundation might be there obtained for the mouth of a canal or outlet to the waters, and this spot would be still more favourably situated for the drainage of the neighbouring Lake of Tacomshin; I, therefore, propose to join these two lakes by means of a canal 2,000 yards long, and nearly parallel to the coast, and from this canal to construct another at right angles to it, directed upon the favourable spot of the sea-shore already alluded to. This second canal would extend 200 yards from the first to the ridge of burrows, underneath which it would be necessary to conduct it by a tunnel 90 yards long, and then to terminate between two piers of granite 40 yards long. Blocks of this stone occur on the shores of Lady Island Lake of a form and size that would require but little dressing.

Tacumshin Lake

Is situated on the south coast of the county of Wexford, at a distance of 1,500 yards west of Lady Island Lake; its extreme length from east to west is two miles and one-third, and from north to south its extreme breadth is one mile and one-third, so that the extreme dimensions of this lake are precisely similar to that of Lady Island. Its mean dimensions, however, are greater, and it contains a surface at high water amounting to 1,027 English statute acres, whereof, I fear, about one-third, say 342 acres, would be unfit for tillage, from its sandy nature, and, therefore, leaving only 685 acres for that purpose when the tides are cut off.

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The shores of this lake towards the land are generally low, so much so, that in south-westerly gales the adjoining fields are in some places flooded. The shore towards the sea-coast is two miles and one-third in length, and consists, as in the lake already described, of a narrow strip of sand-hills or burrows; but when I visited it in November, 1840, I found the sand-hills insignificant, in point of height, as compared with those already described, the reason of which will shortly appear. I was informed that the entrance from the sea to this lake was constantly moving from east to west, and the appearances presented to me were strongly indicative of that fact; for example, the burrows on the west side of the entrance were much higher than on the east side, which last consisted merely of a flat sandy strand for the last half mile, with a regular slope down to low-water mark at the entrance.

It is stated that the entrance progresses from the east end of the lake to the west end, a distance of two miles and one-third in the space of four years; and that, on arriving at the west end, the passage or entrance gets blocked up by storms in the same manner as that of Lady Island Lake; and when this happens, a new entrance is formed artificially at the east end. I do not vouch for this extreme regularity of the motion of the entrance westwards, but believe that the facts bear some approximation to the above statement.

On my visit in November last, I found the entrance further west than shown by the Ordnance Survey executed not long previous; and, in consulting old maps, I find the entrance to be variously placed at various dates. If we assume the statement to be nearly true, it would follow, that the flux and reflux of the tides through the entrance remove nearly half a mile of burrow every year, and that the same is made good again by natural causes; and the long tapering point which I observed on the east side of the entrance, half a mile long, seems to point out the work of one year. In the state in which I saw the burrows of Tacumshin, the lake was open at high water to the inroad of the sea for more than half a mile in extent, and no artificial embankment could be formed to fill this gap at a cost which would be remunerative.

The success, therefore, of reclaiming this lake for tillage from the action of the tide must depend upon the facts stated, viz., that nature will, in due progress, form a sufficient barrier, without resorting to any artificial means; and if this point can be satisfactorily established, I should not hesitate to recommend the plan of drainage which I have already described in treating of the Lake of Lady Island.

Lake of Bannow.

The Lake of Bannow is situated on the south coast of the county of Wexford, towards its western extremity, and it forms the boundary between the baronies of Shelbourn and Bargy.

I have inspected the above sea lake, and have drawn up a plan and report in respect to it; but as I have come to a decision that it does not hold out sufficient inducement to bestow upon it the necessary expenses for reclaiming it from the tides, I have omitted, with your approval, to make further mention of it in the report.

Strand or Mudland of Dumbrody.

This is situated at the west extremity of the county of Wexford, in the barony of Shelbourn, and in the parishes of Kilmokea, and of St. James and Dumbrody.

I have inspected the above tide land, and drawn a report and plan in respect to its being reclaimed; but considering the length of the embankment, and small quantity of land inclosed, and the various claims upon this land, I have, with your approval, omitted any further mention of it in this Report.

JAMES VETCH.

GENTLEMEN, *Birmingham, 2nd January*, 1841.

Since I handed to you my report of the 1st of December last, on the subject of reclaiming certain tide lands in the counties of Wexford and Waterford, I have received from Ireland farther information as to the amount of the tides in the haven of Wexford, and though I find great difficulty in reconciling the conflicting statements, I am now inclined to believe that the height of spring tides generally in the haven is greater than noted in my report.

The discrepant statements in respect to the tides in Wexford Haven are doubtless owing to the great irregularities caused by the accidents of the weather, and no decided results can be arrived at until an extended series of tide observations have been made simultaneously at a number of points, both outside and inside the harbour; nevertheless, from what fell under my observation, I consider I am justified in assuming that the tides in the haven *generally* are one quarter less in altitude, and one quarter later in time than they are outside.

In my report of the 1st December last, I have stated the greatest amount of acres that ought to be attempted to be embanked, either as a measure of profit to the capitalist, or as a measure of propriety in respect to the navigation of the port, and the line of greatest limit was the only one which the state of my information allowed me to offer for your guidance.

In respect to the precise quantity of tide land that ought to be embanked, with the single view of rendering the tides most beneficial to the navigation of the ports of Wexford and Enniscorthy, that question can only be resolved when the tide observations alluded to have been made and brought into computation; but I have some confidence in now saying that the quantity required will not exceed one-third of the entire surface of high water of spring tides, or fall short of one-sixth of it.

Under the above modified view of my report, I would now recommend that you only proceed with the northern embankment in the first instance, as comprising a quantity of surface on which there can be little room for doubts or differences of opinion; and this recommendation will possess the more weight, inasmuch as you cannot proceed with any works of this nature until the sanction of the Admiralty is obtained; and, however well disposed their Lordships may be, it is not to be expected they would sanction the execution of both embankments until the effects of one of them had been fully ascertained.

I have, &c.,
JAMES VETCH.

To Messrs. Deans and Dunlop,
23, *Fludyer-street, Westminster.*

No. 41.

Rendel on enclosing Wexford Slobs.

No. 41.

Report of JAMES M. RENDEL, C. E., *on the Embankment of the Mud-lands of Wexford Harbour.*

SIR,

20th July, 1844.

In obedience to the commands of the Lords Commissioners of the Admiralty, communicated to me in your letter of the 27th of May last, I proceeded to Wexford in the early part of June. In my survey of the harbour I was attended by Mr. M'Call, the author of the plan for embanking its mud-lands, referred to in Mr. Pim's letter of the 24th May to their Lordships, a copy of which was transmitted to me in yours of the 27th May. I had also the great advantage of Commander Frazer's chart of the harbour and the adjoining coasts, completed this year, and a variety of other papers; all of which tended to abridge the labour of my survey, though it furnished an amount of information which required time for consideration, and in some degree prevented my making an earlier report.

The town of Wexford is situated about four miles from the sea, through an estuary of about 13,000 acres area, of which 10,000 acres are mud-lands, dry at low water of spring tides.

The object of the promoters of the scheme under consideration is to reclaim these mud-lands, by means of two embankments extending from the town to the sea, so as to confine the land and tidal water between these banks, which will consequently become defences for the reclaimed land, and the boundaries of a new channel for navigation between the sea and the town. This new channel, it is alleged by the promoters of the plan, will be greatly superior to the present channel; it will be straight, and of a convenient and uniform depth; whereas the present channel is very crooked, and encumbered with bars and other similar impediments. But what is of still greater importance, the promoters allege that by making a new entrance for the harbour as they propose, about 2½ miles south-west of the present entrance, its dangerous sand-banks and bar will be avoided, and the new entrance will not be liable to similar formation It is also stated, that by confining the tidal water within the proposed embanked channel, the flow at Wexford Quays, which is at present in spring tides from four to six feet, will be increased to seven or eight feet, whilst at neap tides it will be increased from four to six feet, to six to seven feet.

Such are the statements of the promoters of this plan; and certainly, if they are correct, they should be encouraged in their endeavours to bring about a change so beneficial to the port. I fear, however, that their conclusions have been drawn before they were in possession of a sufficient amount of observations to warrant them. At all events, before I should feel justified in approving of their proposition, I should require to be furnished with the results of an engineering survey of the banks and tidal currents between Greenore Point and the north end of Raven Burrows; also of tidal observations at guages to be fixed at Greenore Point, at the spot proposed for the new entrance, at the present entrance, at Wexford Quays, at Carrig Bridge, and at the highest point up the Slaney river to which the tides flow. Such a survey and set of observations would doubtless be attended with a considerable expense; but in my opinion the information which already exists respecting this question is not satisfactorily available for the determination of its details, in the absence of the facts which such a survey, &c., can alone elicit.

Enough of information is, however, now before me to warrant my giving an opinion that a large tract of the mud-lands might be reclaimed with advantage to the harbour, provided the embankments necessary for that purpose were properly designed and executed; and *I can with confidence recommend the measure as one well worthy of encouragement*. Situated at the entrance of the Irish Channel, Wexford is conveniently placed for commercial purposes, whilst, from its being at the south-east extremity of Ireland, and distant only 43 miles N.N.W.½W. from St. David's Head, on the coast of Wales, its position and proximity to England point it out as admirable for a packet station.

In its present state, however, these advantages of position are of but little avail. According to Commander Frazer's chart of last year, the depth of water on the bar is not more than from six to seven feet at low water, whilst spring tides cannot be safely calculated to exceed a rise of more than five feet, and neap tides a rise of only from two to three feet. The greatest depth, therefore, on the bar must be taken as not exceeding 12 feet, whilst at neap tides it will not exceed 10 to 11 feet. Such a limited depth of water in connexion with the width of the bar, and great extent of the Dogger and other sand-banks in its immediate vicinity, limits the use of the port to vessels of a very small class; and being an evil at its very threshold, any internal improvements which do not extend a beneficial influence to the entrance would be of little avail indeed.

With this view, the promoters of the plan submitted for my consideration, and which I attach to this report, propose blocking up the present entrance, and making a new one from South Bay, about 2½ miles south-west from the present entrance, and where there is deep water, and, as they say, true tidal currents, and no danger of a bar being formed. Their plan is to form this entrance by cutting through the solid mud cliffs of this part of the coast to a depth of 20 feet below low water of spring tides, which, it must be admitted, would be a work of great labour and expense.

But supposing it accomplished, and the channel from it to the town of Wexford, made and maintained without a bar, and to the depth assumed, by scour of the land and tidal water, then it must be admitted that the harbour would become one of great resort, both for commerce and packet purposes, for it would unquestionably be the best and most accessible port on this coast.

I have said before that I am not in possession of sufficient facts to be able to corroborate the plans or the expectations of the promoters, and I must add that I cannot recommend the sanction of any attempts for the execution of those, or, indeed, any other plans for the reclamation of the mud-lands, or alterations in the harbour, until the kind of survey and tidal observations before suggested are procured and maturely considered, with the other information already obtained.

In conclusion, I may be permitted to remark, that, whatever may be the result of any further investigation into the possibility of making the harbour of Wexford a safe and convenient packet station, I think its position so favourable, that, should its improvement be impracticable, it will become a proper matter for inquiry what part of the coast in its immediate neighbourhood is most eligible for the site of an artificial harbour suitable for vessels drawing three fathoms of water; and I strongly recommend that in case of any further surveys and inquiries being made on the subject of Wexford Harbour, the same should be extended so as to include the coast as far west as Carnsore Point.

Summarily, I am of opinion that the importance of Wexford Harbour is such as to make it expedient for the Lords Commissioners of the Admiralty to encourage the promoters of any well-considered plan for its improvement.

That the embankment of a great extent of its present mud-lands might be made a means in aid of such improvement.

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That sufficient information as to the tidal currents and their flow, and as to the position of the banks and channels at the present harbour's mouth, has not been obtained to express an opinion on the suitability of the plan submitted to me, and that if this further inquiry is to be made, it should be extended so as to embrace the coast as far west as Carnsore Point.

I have, &c.,
JAS. M. RENDEL.

To Sir John Barrow, Bart.,
Secretary of the Admiralty.

No. 42.

No. 42.
Frazer on the Improvement of the Harbour.

CAPTAIN FRAZER'S *Suggestions for the Improvement of Wexford Harbour.*

H. M. Surveying Vessel Lucifer,
Waterford, June 20th, 1845.

SIR,

In obedience to your wishes, I have the honour to send you an outline of suggestions recommended by me to the Commissioners of the town of Wexford, for the improvement of the harbour and its approaches.

Taking into consideration the important position and trade of Wexford, as well as the great increase of traffic that is likely to result as a consequence when Wexford shall be included within the bounds of railway communication, and taking into account, also, that it is an essential object that improved facility, if possible, should be given to the ingress and egress of steamers, I cannot help thinking that the experiment of improving the harbour, as suggested by me, is worth the trial, especially as no possible harm can result from it, even if it should not produce the effects anticipated, and it will involve, comparatively speaking, but a trifling expense.

I am aware that within the last 30 years some of the most eminent engineers have been consulted on the subject, whose opinions have differed as to what should be done—all, however, having suggested the formation of considerable works, involving an immense outlay of capital, the result of which could at the best be only problematical.

From long and close observation of the tides, as well as the nature and character of the shoals which sweep round the entrance to Wexford, I feel warranted in concluding, that any works thrown out with a view to scour a more direct channel in would prove unavailing, and that they would only tend to remove the impediment some little distance farther out, thereby making bad worse; and even if successful in making a clear passage out, no vessel would venture to approach it with a north-easterly tide opposed to an easterly gale. Indeed, it is on this account the Hantoon Channel is so valuable, as evidenced in practice; for although there is better water on the north bar, all vessels frequenting the port avail themselves of Hantoon on account of its sheltered position, even with an opposing wind, the tide being at all times sufficiently strong to enable them to "back and fill" in, provided it is not blowing too hard. Under all these circumstances, and with the views I have formed on the subject, I would recommend that means should be adopted to assist in the improvement of the natural channel (Hantoon,) by deepening and widening it to a limited extent, by means of a steam-dredge. On suggesting this, nearly three years back, it was objected to, as it was then said, "that "deepen the channel as you will the first easterly gale will fill it all in again;" however, the Commissioners tried the experiment in a limited way, by raking to the depth of a foot (a means not to be used, excepting under peculiar circumstances, as it merely disturbs the bottom from one part to deposit itself in another); however, the experiment was a useful one in the present instance, as I have been assured that up to the present time, although there have been since many and severe easterly gales, the channel has maintained its increased depth, an evidence that the steam-dredge, if judiciously managed, would produce the effect anticipated.

Independently of the deepening of the bar, I think it necessary also to point out the absolute necessity of a steam-dredge for the internal improvement of Wexford Harbour, there being much work for one, to remove (amongst other impediments) the inner or Gulbert Bar, a serious obstacle to the trade of the port, and where she could be well employed, when the weather, or other causes, might prevent her working on the outside bar.

I cannot think that any good would result by dredging the North Bar, it being a fine, shifting sand, and would, therefore, immediately fill in again; on the other hand, the South Bar, or Hantoon Channel, is of hard gravel, and, as has been proved, would not fill in again. For many reasons, indeed, the Hantoon Channel is to be preferred; for instance, the prevailing wind (south-westerly), is a leading one in, and even, with a contrary wind, it is sheltered by the Raven spit, and the flood tide is at all times strong enough to carry a vessel in if managed properly.

I enclose a tracing from my survey of the bar, for the purpose of showing the extent to which I would recommend the deepening of Hantoon to be carried; and, as a guide for the working of the dredge, would recommend the erection of three beacons, as marked (in Raven Point) A, B, and C, the limits to be the transits A, B, and A, C, and to a depth of 10 feet at low water in the first instance.

It is not for me to enter into the detail of the probable expenses of such an undertaking, nor could I do so, not knowing the cost of a steam-dredge; but the working of one, together with five or six barges, (to carry away the matter dredged up,) the coals, and superintendence, would not exceed for the first year 800*l.* or 900*l.*, for which there is no saying what incalculable advantages might be derived.

Submitting these observations and suggestions to your consideration,

I have, &c.,
GEORGE ALEXANDER FRAZER, Commander.

Captain Beaufort, R.N.,
&c. &c. &c.

No. 43.

No. 43.
Airy on the Improvement of the Harbour.

On Wexford Harbour. *By* G. B. AIRY, Esq., Astronomer Royal.

Royal Observatory, Greenwich, 21*st July*, 1845.

In stating to the Tidal Harbours Commission my opinion regarding the measures proper for the improvement of Wexford Harbour, I think it right to state the sources of my information upon the

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condition of that harbour. I have no personal acquaintance with Wexford, but I have carefully read the Reports of Sir John Rennie (1831), Mr. M‘Call (1837), Mr. Cubitt (1838), Captain Vetch (1841), and Mr. Rendel (1844), as well as Captain Frazer's letter (1845). But above all, I have diligently studied Captain Frazer's admirable chart, (1843). I have no doubt that, after examination of these documents, and careful reflection upon them, I am much better acquainted with the state of the harbour than I possibly could have been from any personal inspection.

It is not my intention to criticise in order the Reports to which I have alluded. I shall have occasion, however, to remark specially upon Mr. M‘Call's proposal, and generally upon the recommendations which appear in some other Reports.

Referring, then, generally to Captain Frazer's chart, I shall proceed to notice the most remarkable circumstances of Wexford Harbour.

The first extraordinary circumstance is the relation of the extent of the harbour to the width of its entrance. The length of the basin, north and south, exceeds 8 miles; the average breadth (including in our estimation of extent the smaller basin above the town of Wexford) is perhaps nearly 3 miles. The whole tidal surface is, therefore, about 24 square miles, and the whole of this is filled and emptied at the same tide. The width of the entrance is less than half a mile; consequently, the discharge is the same as if there were a river of the same width as the entrance, but 50 miles long, to be filled and emptied at every tide. I think it probable, that in no other harbour in the world is the "equivalent channel" so long as in this.

The rise of water in spring tides is about 6 feet. If, then, the average depth at the entrance were 12 feet, the length of the column of water to be run out in six hours would be 25 miles, implying a maximum velocity of about 6 miles per hour. It is evident that this is sufficient to tear up the bottom at the entrance of the harbour very rapidly (unless it were rocky; it is, in fact, clay and gravel), and to increase the depth enormously, until it becomes so great, that from the increase of section thus produced the current will be less rapid.

The second extraordinary circumstance is the relation of the depths of water, at and near to the entrance of the harbour. In the channels within the harbour, the depth (at low water) is 6 to 9 feet. In the narrowest part of the entrance it suddenly deepens to 50 feet, and then immediately on the outside it shoals again, till (I believe), in no place whatever is there a passage with more than 8 feet depth. This state of bar continues for half a mile or a mile (to different distances in different directions), and the depth then gradually approximates to that of the neighbouring sea, north and south of the harbour.

The connexion between the second circumstance and the first is obvious: the enormous tidal current has scooped out the entrance of the harbour to a great depth, and the matter thus disturbed has deposited itself on the bottom of the sea at the smallest distance at which the motion of the water was sufficiently slow to allow it to rest. The effect of the tidal current has been precisely the same as if a dredging-machine had been employed to dredge the entrance very deep, and to discharge all the matter so raised within a mile of the entrance.

It fortunately happens that the form of the Wexford Basin enables us to illustrate this action in various degrees. Above the town of Wexford there is a small tidal basin, with a surface of about 2 square miles. The channels in this small basin are 12 to 18 feet deep; the depth at the entrance of this small basin (opposite Wexford) is 19 to 26 feet; below Wexford, at the same distance from the entrance of this small basin as the distance of the exterior bar from the entrance of the great basin, it becomes 10 feet; and afterwards 5 or 6, in the centre of the wide expanse of the harbour. It is evident, here, that the small basin has produced an effect analogous in kind to that of the great basin, but smaller in degree; it has not scooped its entrance so deep, and has not deposited the matter so heavily immediately beyond that entrance.

Some of the engineers, in the Reports to which I have referred, have recommended, with a view to the improvement of the passage over the exterior bar, that the currents of the ebb from the great basin should be so directed as to act with even greater force at the entrance than they do at present. As regards this special instance, I have only to remark, that this amounts to the same as recommending that, when one dredging-machine is found to be impeding the approach by deepening the entrance, and depositing the raised matter all round the entrance, another dredging-machine should be placed, so as to double the injurious effect of the first. But, as regards the effect of such tidal currents in general, I think it proper to express my opinion, that a great mistake has frequently been committed by engineers, in supposing that a rapid efflux is necessarily beneficial to the entrance of a harbour. When the entrance is narrow, the action of the sea always tends to spread the sand and shingle across it, so as to form a line continuous with the bank on both sides of the entrance; and to keep that entrance clear for navigation, it is indispensable to have such an efflux as will be capable of bursting through such a line of sand or shingle. But in the case of Wexford we have an efflux many times greater than is necessary for that purpose, and the effect of such a great efflux, as I have said above, is purely injurious.

I conceive, therefore, that it is perfectly certain that the first great step to the improvement of the entrance of Wexford Harbour must be *the contraction of the tidal surface of the great basin*. I cannot say how much ought to be left; but I should suppose that if four square miles were left, in addition to the smaller basin, that extent would be amply sufficient for keeping the entrance deep, without raising a bar on the outside.

Supposing this determined on, the next consideration would be, what steps should be taken to secure a deep channel outside the entrance? Should a channel be dredged from the present entrance through the bar? or should a new entrance be cut from the large basin into the deeper water north or south of the bar, the contracting works of the basin being directed accordingly? And if the latter, where ought the new entrance to be?

I imagine that the cross tide would very soon fill up any channel which should be cut through the bar. I shall therefore proceed to the consideration of an alteration of the entrance; and first, I shall remark on the plan proposed by Mr. M‘Call.

Mr. M‘Call's plan, as I understand it, was to cut a channel from the town of Wexford, nearly straight, in a south-easterly direction, through the mud of the great basin, and through the cliffs, to the bay, south of the bar. As regards the inclosure of a great proportion of the basin, and the forming a new entrance in a part that appears liable to no objection on the score of external approach, I assent entirely to the general principle of this plan. But there is one objection to it which has not been remarked by the engineers who have commented upon it, but which, nevertheless, is, in my judgment, indisputable. The proposed new channel would make such an angle with the channel

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which passes the quays of Wexford, that Wexford would be left upon a point of land with the channel bending round it. The consequence of this would infallibly be, that the whole scouring power of the channel would be turned upon the opposite or concave side of the channel, and the quays at Wexford would very soon be blocked up with mud. (A similar injury has been produced at Lynn, by the change of a river channel.) This would be an evil so serious, that I conceive that Mr. M'Call's plan must, on that ground, be at once laid aside.

Considering it, then, absolutely necessary, for the interests of the quays at Wexford, that the existing bend of the channel to the east, immediately after passing Wexford, be preserved, I imagine that the only feasible plan which can be proposed is the following:—The eastern reach of the channel extending from Wexford is to be preserved in its present form, and the north-eastern reach which follows it is also to be preserved and to be continued a little way till it reaches the angle of Big Island. Here the channel, instead of turning to the south east, as at present, is to be turned to the east, and, passing close to the Breast Island and Little Breast Island, is to be carried through the burrows into the sea. It would be preferable, if possible, to carry the channel a little further north than I have mentioned; and if there is no difficulty in removing the small islands, it would be best to carry the channel through the place where these islands at present stand. The old entrance must be stopped, and all parts of the basin not specified above must be embanked.

The channel would thus enter into much deeper water than that of the South Bay, to which Mr. M'Call's proposed channel leads.

The course of the sea-tides exterior to the barbour and bar appears to be what I believe is usually called "tide-and-half-tide." And the effect appears to be, what may be anticipated in such circumstances, that there is no decided tendency to incline the mouth of the entrance-channel either to the north or to the south. I expect, therefore, that a new entrance would nearly retain the position that should be given to it, without any particular tendency to incline the direction of its mouth.

The works for the plan which I have proposed would be much less than those for Mr. M'Call's plan. But whether their expense would be too great to admit of their practicability I am entirely unable to judge.

G. B. AIRY.

No. 44.

Mr. WARE, C.E., *on the Improvement of the Harbour of Wexford.*

No. 44.

Wark on the Improvement of the Harbour.

GENTLEMEN,

London, 30*th July*, 1845.

I beg to send for your inspection a plan which I proposed, in October 1844, for the improvement of the harbour of Wexford, and to offer a few observations, which, if my plan be not considered perfect, may still possibly be of use as suggestions in reference to a better project

The river Slaney is of considerable size; its source is in the mountains above Newtown Barry, and on reaching Enniscorthy, 14 miles above Wexford, it then comes within the influence of the tide. From Enniscorthy to the Castle of Deeps, a distance of six miles, it has a very bad draught of water. The bottom is of a very loose sharp sand; and as the tide only rises from one to two feet, there are never more than from two to three feet of water above that place, except during floods. From the Castle of Deeps to Carrig Bridge, a distance of about six miles, the river runs through bog, with high ground on each side, and is very deep, averaging from 18 to 30 feet, and about $\frac{1}{8}$th of a mile in width.

At Carrig Bridge, where it is confined to 135 yards width, it is about 50 feet deep; but it again expands, into what is called the Inner Harbour, for a distance of two miles, where the average depth is from 16 to 18 feet, till it passes the harbour of Wexford, where it is about 200 yards in width. On passing the Slip Dock it again expands till it reaches the second direction-post, and as it gets wider the depth of water decreases till it reaches the Gull Bar, where there is not more than 12 feet water at highest tides. From that place it varies in depth till it comes to the point where I have projected the embankment, where it it is about 14 feet. Below this the channel becomes deeper to the junction with the Coal Channel, and it deepens more still, till it reaches the Fort of Rosslare, where it is about 40 feet deep. The channel here at low tide does not exceed 600 yards in width, and at highest tides not more than 1,200 yards; but immediately below this is the open bay, and at Hantoon Bar the depth is not more than 12 feet at the very highest tides. Vessels at that place are confined to a very narrow course between the Dogger Bank and the shore for nearly two miles, where it is quite impossible for them to tack against a south or south-west wind, which is the prevailing one, and many vessels have been detained in the barbour a longer period, than had they cleared this passage, they would by the same wind have accomplished their voyage.

Mr. Wark's plan shows an embankment across the Slaney at Park Point, thereby turning its stream through a cutting to be made in an easterly direction past Beg Erin, through Curraclee Burrow into the North Bay. A canal is to join Beg Erin channel with the barbour just south of Wexford Bridge. A dam is to be placed across the barbour below the ship-yard, thus forming a floating basin from that spot to Point of Park. The present entrance to the harbour to be closed up, and all the mudlands to be reclaimed.

I have only to add, that wherever the River Slaney is confined to its natural width, it keeps its course clear and deep. The channel of the River Slaney from Enniscorthy to Carrig Bridge runs over a surface which, in square measurement, would amount to about 1,100 acres, and 600 acres more from the inner harbour would form a total area of 1700 acres of reservoir to the tide. Were the fresh water from the river directed according to my plan, by an embankment, in a straight line towards the sea, the channel would be kept clean and deep by the addition of the fresh to the tidal water on the reflux or ebb. The present entrance to the harbour is only about 800 yards width, except at high tide, which overflows at present a surface of about 14,000 acres; but by the plan, the waters from the proposed surface of 1700 acres would pass through a channel of 100 yards width, and with an equally effective impetus in respect to scouring the passage, as the water from the 14,000 acres are through their present passage.

More than nine-tenths of the shipping trade from Wexford go to the north, or up the channel, and, according to the plan, vessels could get to sea, and be many miles on their voyage before they could, in the present state of the barbour, get out even with a fair wind, and vessels could either come in or go out of the harbour by any wind except due west or east.

The lime-works, which are very extensive in the neighbourhood, would also be served much better than at present, by a catch-water river or canal from Killinnick passing them in a straight line to the harbour, in place of going round by Coal Channel. I have also marked with a pencil upon the plan the line of a canal to the South Bay which might be cut at some future period, provided the north passage did not

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prove so successful as expected for the shipping, and which could be executed when the ground was laid dry, for one-fourth of the expense it would cost were it proposed now, with the tide flowing over the ground twice every day. But I believe it would never be required, as the north river is certain to preserve its depth. The sand hills from Raven Point to where it is proposed to make the new entrance are very high, in some places 40 to 50 feet; but where the new entrance is proposed there is a passage by which the tide ebbs and flows in very high spring tides. During neap tides it only rises three to four feet in the harbour, and at ordinary spring tides five to six feet; and in the bay outside it is one to two feet more.

I have, &c.,

JOHN WARK.

To the Tidal Harbours Commission.

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Farrell on the Improvement of the Harbour.

Report of JAMES B. FARRELL, Esq., C.E., *on the Improvement of Wexford Harbour.*

GENTLEMEN,

Wexford, January, 1846.

With reference to the three plans which I have had the honour to lay before you for the improvement of Wexford Harbour, I have drawn up the following report in accordance with your instructions.

In order that you may be better able to form an opinion upon them, I shall as briefly and simply as I can, state generally what the present condition of the harbour is—what remedies would, in my humble judgment, be most likely to effect its perfect improvement, and then submit to you how far the return that you might expect from the reclamation of the mud-lands would enable you to carry these remedial measures into effect.

An examination of the annexed maps will afford you a much better idea of the shape and position of the locality and its boundaries than any written description could convey.

In contemplating the improvement of a tidal harbour, one of the first and most important objects of consideration is the extent of its tidal basin, for it is by that principally that such a large and effective influx of water is to be obtained as may be necessary, in its return to the sea, to keep the entrance free from obstructions. But it is of no less importance to direct and regulate that quantity, so that it shall produce no excessive velocity; as this excess might be the cause of evils fully as injurious as those resulting from too great a diminution of what is termed the "scouring power."

In harbours receiving the waters of large rivers, such as the Slaney, I am firmly impressed with the belief that, consistently with the principles just laid down, the more gently the river and ebbing tides flow to meet the ocean, the less reason is there to apprehend the formation of bars, provided that, by giving the waters a proper direction and depth, and removing all injurious obstructions, a uniform momentum is afforded, approaching, as nearly as possible, to that resulting from the propagation of the tidal wave outside.

The total area of the tidal basin of Wexford Harbour is 22 square miles, extending from the entrance to Enniscorthy, a distance of more than 21 miles. It may be divided into three portions, thus—

1st. The river Slaney, from Enniscorthy (where the tide ceases to flow) to Ferrycarrig Bridge, 1½ square miles.
2nd. From Ferrycarrig Bridge to Wexford Bridge, 2 square miles.
3rd. From Wexford Bridge to the harbour's mouth, 18½ square miles.

At Enniscorthy the river is about 200 feet wide, and as it descends this width increases, rather uniformly, for about five miles, when it is interrupted by islands and marshes for about two miles farther down. These seven miles are obstructed by shoals, which render the navigation impracticable in that part, except for flat-bottomed boats.

From this forward, the depth of water varies from 8 to 60 feet at low water, and the width is irregular. On reaching Ferrycarrig Bridge the river is suddenly contracted to about one-sixth of the width that is immediately above. Here it passes and expands into the second basin, and, as may be expected, from the great velocity of transit through this narrow channel (which it has deepened and scoured), carries with it a large quantity of matter, which it deposits as soon as its velocity is checked; first, by the expansion of the water, and again, by the force of the rivers flowing, in a nearly contrary course, from the estuary terminating at Castlebridge.

At the junction of these rivers with the low-water course of the Slaney, the depth of the latter is reduced from 60 to 12 feet, and its direction is turned, in a very sharp curve, round the point of the large mud bank, called "The Point of Park" (which has been thrown up, probably, by the conflicting forces of the rivers.) After passing this point the depth begins to increase and the width to diminish, until it reaches the town of Wexford, where another natural contraction takes place, but which has been further narrowed to about one-third of its original dimensions by the erection of causeways to connect the bridge with the land on either side. Here, no doubt, an effect would have been produced proportionately similar to that at Ferrycarrig, had not those interested in the stability of the bridge thrown in, from time to time, large stones to protect the piles, and thus erected a weir across the bottom of the river. The water over this obstruction is 18 feet deep at low water. After passing it and entering the large estuary (forming the third portion of the tidal basin, and called "The Harbour"), the bed of the river has been ploughed out to a depth of 33 feet, which gradually diminishes until the depths are lessened to eight, seven, and six feet. This shallow is continued along the harbour until the influence of the rapid and enormous draft of water, through the narrow opening into the sea, begins to act upon the bottom, deepening it 9, 12, 15, and 24 feet, and then suddenly to 50 feet, which is the depth between the Raven and Rosslare Points.

Thus the entire sediment of the Slaney discharged from a catchment basin of 815* square miles, together with that of other minor rivers, and the soil forming the natural bed of the harbour itself, is alternately torn up and deposited, until it finds a resting place, in the shape of banks, outside the harbour's mouth, that act as traps to catch the sand thrown up from the sea in times of storm.

I have made a series of transverse sections of the river and harbour from above Ferrycarrig Bridge to the Dogger Banks, outside the harbour's mouth, which is appended to this report, and exhibits at one view the condition of both as here described.

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* This area is taken from Doctor Kane's "Industrial Resources of Ireland."

I shall now endeavour to illustrate numerically the amount of excess of velocity which causes the obstruction to the entrance of the harbour, where there is a depth of only eight feet at low water over the bar.

The area of the tidal basin, as stated before, is 22 square miles. The height of a spring-tide spread over this extent may be taken at three feet six inches There are, therefore, 2,146,636,800 cubic feet of tidal water to be discharged through the harbour's mouth, during, say, the six hours of ebb, or 357,772,800 cubic feet per hour.

Now the area of discharge (taking the height of the tide at the mouth to be five feet) is 14,000 square feet.

The mean velocity required for emptying the basin is therefore, 25,555 feet per hour, or seven feet per second in this case.

The areas of the catchment, or rain basins of the Slaney, and of the smaller rivers discharging into the harbour below are, taken together, 880 square miles. In times of flood, this total rain basin would deliver 340,736,000* cubic feet of rain in six hours, so that then, during an ebb, the quantity would be

Of tidal water, 2,146,636,800 cubic feet,
River ditto 340,736,000 " "

Making a total of 2,487,372,800 " " in six hours, requiring a mean velocity through the harbour's mouth of 29,611 feet per hour, or eight feet three inches per second.

It has been ascertained, from the observations of Du Buat and others, that a velocity of three inches per second at the bottom will just begin to work upon fine potters' clay, and however firm and compact it may be, it will tear it up; six inches per second will lift fine sand; eight inches will lift sand as coarse as linseed; twelve inches will sweep along fine gravel; twenty-four inches will roll along rounded pebbles an inch in diameter; and three feet per second will carry with it shivery angular stones of the size of an egg.†

Reducing the mean velocities found requisite (as in the foregoing calculations) for delivery at the harbour's mouth, to the velocities due to them at the bottom of the stream, where friction retards the motion, the results will give, in the first case (where the tidal water only is taken into account), six feet three inches per second, being more than twice the velocity that will carry along stones the size of an egg; and in the second case (where the land floods are added to the tidal stream), seven feet five inches per second, or nearly two and a half times greater than the same velocity.

It is not, however, to be understood, that the whole force of this current acts upon the bottom of the harbour's mouth. The results that I have quoted are referrible to cases where the waters moving with the given velocities are in contact with the beds of streams. In the present case the surface of low water represents the bed.

I am not able to say exactly what is the amount of disturbing effect produced by the velocity of the upper stratum upon the body of water below low-water level: but as the bottom of the harbour's mouth consists of gravel, it must be equal to a velocity of from 12 to 24 inches per second (about one-sixth of the velocity at low-water surface), from the example it affords of its power in ploughing up the bottom to its present depth.

I have now laid before you what appears to me to be the great source from which the bad state of the harbour springs. There are minor causes, with a detail of which, as they are all very nearly consequent upon what I have been endeavouring to explain, I shall not delay you.

The shape of the "Harbour," however, should not be passed over. It may be best illustrated by comparing it to the vertical transverse section of a low bottle with a narrow short neck, and a width equal to nearly four times its height. The low-water channel passes through it in the shape of an irregular S. On its northern side is a tract of mud-land, five square miles in extent; and on the south is another tract of a similar description, containing nine and a half square miles.

The flood tide gradually rises over these large areas until it attains a height above them of about three feet at spring tides. Bearing in mind the shape of the harbour and its entrance as just described, the obstruction to the free flow of the tides in and out is almost obvious, as is also the necessity for collecting and directing the stream.

That the tide is later in reaching its height at the quays of Wexford than at the entrance is likewise easily understood, when the large area of 18½ square miles is compared with the width of the mouth, which is not half a mile. It must, too, be remembered, that it is not over an expanse of water alone that the tide has to spread itself, but that nearly four-fifths of the area is mud-land, covered with sea-grass, in flowing through which the friction must greatly retard the tidal progress.

Annexed to this report is a tide table, from which it will be seen that during spring tides, when the range of tide was greatest at Greenore Point, it was, high water at the harbour's mouth half-an-hour earlier than at Wexford quays, and an hour earlier during neap tides. During spring tides, when the range of tide was least at Greenore Point, the difference of time was 20 minutes; and during neap tides, when the range was least, the difference amounted to an hour and twenty-seven minutes. So that in all states of the tide it is high water at least half-an-hour earlier at the entrance than at the quays. The prevalence of strong south-east winds, when those observations were made, hastened the tide into the harbour. The times of difference may therefore be taken as approaching a minimum.

At high water of neap tides, about one-half of the mud-lands are covered to depth of about one foot, flowing, as before remarked, slowly through the sea-grass, and off a nearly level surface. The water that covers the mud during those periods can add very little effect to the scouring power of the ebb tide.

Having thus given you what appears to me to be the general condition and disease of the harbour, I shall point out what remedies would, in my opinion, be most likely to effect the largest amount of improvement. They are as follow:—

1st. Deepening the River Slaney, and regulating its width from Enniscorthy, so that there should be the same rise and fall of tide there as at Wexford.

2nd. Widening the pass of Ferrycarrig Bridge.

3rd. Erecting a jetty to direct the Slaney in a gentle curve round the "Point of Park," from Saunderscourt Point towards the opposite shore, so as to shut up the present channel of the rivers

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* This calculation is made on the received opinion that $\frac{1\cdot65}{0\cdot40}$ inch is the maximum of rain waters generally delivered by rivers from their catchment basins, in this country, in twenty-four hours.

† Robison on Rivers.

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coming from Castlebridge, and to lead their waters through a new cut into the main channel, in the direction of its current of ebb. At present they meet that current.

4th. Dredging away to at least 11 feet below low water the whole of the mud bank, called the "Point of Park."

5th. Removing the bridge and causeways at Wexford, and opening the high water channel to its original dimensions.

6th. Contracting the high water area of the tidal basin below the bridge by embankments, so constructed as to collect and lead the ebb and flood by the best direction in and out of the harbour to and from the deep water of the north bay.

7th. Dredging the whole of the new basin to a uniform depth of eleven feet below low water of spring tides, and removing all injurious obstructions.

8th. Widening the mouth of the harbour to about three-fourths of a mile at high water, and dredging the bottom of the additional width out into deep water.

9th. Encouraging, by piling, planting bent-grass, and other necessary means, the growth of Dogger-bank into a permanent island.

10th. Dredging Hantoon Channel, and thus obtaining the great advantage of two entrances, one from the north and the other from the south, having Dogger Island detween them.

If these things were done, I have no doubt that the results would be the reduction of high and low water at Enniscorthy to one level with high and low water at Wexford. The whole fall is very nearly absorbed in the first eight miles of the river from the former town

Thus with attention to a proper local conservative system, the bed of the river and harbour would be reduced in time to one gentle declivity, answering a uniform ebb and flood from Enniscorthy to the sea, and I have strong hope that no sand banks would be formed outside by those alterations. But if all these improvements are to be delayed until they can be undertaken by a company, who will execute them with the hope of being repaid by the reclamation of the mud-lands, the harbour must perhaps for ever remain in its present wretched condition; and while the whole civilized world is teeming with improvements, the trade of Wexford (depending on its present port) will remain stagnant—a mere unit in comparison with what should be the commerce of probably the most important position in Ireland.

It is, therefore, highly probable, that the only attainable means of present improvement are to be found in what nature has placed within the harbour in the shape of its mud-lands.

How far their value will enable you to carry into effect the most important of the projects I have enumerated, I shall now endeavour to explain.

In accordance with your instructions, I have taken into consideration three views of the subject. I have appended a map and plan of each. The first is a proposition for making a new entrance from the south bay, closing up the present entrance, and enclosing the new basin by one embankment, starting from Ferry Bank, crossing the harbour so as to preserve, at least, the same width of channel in front of the quays as the original and natural width at the starting-point, and gradually curving to the south-east, until it joins the point of Woodtown, from which a cut to the sea should be made through the lands of Rosslare. The channel through this and the mud land should be excavated, to afford a basin of the same capacity as that of the present low-water basin. with a sailing course of 200 yards wide, of a uniform depth of 11 feet below low water of spring tides. The second proposes another new entrance from the north bay, and as before, the present entrance should be closed. Two embankments are here required: that on the north starts from high-water mark at Ferrybank, curves round about a quarter of a mile behind the ballast bank, until crossing "Beg Euin Channel," it joins "Big Island," from the eastern end of which it again commences, and bends off to the north, the curve being gradually reversed until it joins the narrow part of the sand hills near Curracloe. The southern embankment starts from the end of the "Dock-yard," bends round through the centre of the large mud bank, bounding "Coal Channel" on the north, after leaving which it crosses the harbour into the mud-lands on the opposite side, and passing between "The Raven" and "Breast Island," leaving the latter about midway between it and the opposite embankment, parallel to which it is continued to meet the sand hills. The excavation in this plan should afford similar accommodation as in the former.

In the third design it is proposed to retain but improve the present entrance by constructing two embankments. The northern embankment is the same as that in the second plan, as far as "Big Island," from the eastern end of which it is carried to join the "Raven Sand hills," near their southern point. The southern embankment starts as before, from the "Dock-yard," and passes, in a gentle curve, to the south-east end of the "Gut of the Knob," where it enters "Coal Channel," across which it passes obliquely in a north-eastern direction, until it joins the town land of "Rosslare Fort" at its southern boundary, in the same curve that nature has formed from this to the mouth of the harbour of the "Point of the Fort." The present sailing course would be dredged out to a depth of 11 feet below low water of spring tides, and 200 yards wide, passing through "Hantoon Channel." It is further proposed to pile round the eastern end of "Dogger Bank," and to protect the point of the Fort in the same manner.

In each of these plans it is intended to remove the bridge and causeways of Wexford,—to build another bridge, north of the present site, leaving the full width of water-way, and regulating the width of the river by embankments, from the point of Crosstown on the east, and from Mr. Eakin's bathing-house, on the west of the river, to the site of the present bridge, with suitable approaches,—to remove the "Ballast bank," and, of course, to close up effectually all the gaps in the sand hills.

It is also proposed to deepen the river Slaney from Enniscorthy to the deep water at Pouldarring, so that its bed all through shall be seven feet below low water of the lowest spring tides at Wexford.

The advantages of the first plan are, that but one half the length of embankment that is necessary in the others is required for enclosing the new basin, and that the present low-water basin, when the sea was shut out, would form a reservoir into which all reclaimed mud-lands might be drained. But, independent of other disadvantages, the cost of the excavation alone would be unreasonably expensive.

The second plan (in which it is proposed to make the entrance from the north bay), leading out into deeper water, where there are no banks, such as the Long bank and others that lie outside the south bay, is preferable to the first, over which it has other advantages; but, as in the former case, the cost would be too heavy.

In both the foregoing plans it is necessary to provide for closing the present entrance—an experiment which, considering the important interests at stake, I should be unwilling to recommend.

It appears to me, then, that the third plan (retaining and improving the present entrance and basin)

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is decidedly the most eligible, and one that can be adopted, with the promise of results at once certain and beneficial.

In laying out the works for it, I have borne in mind the large series of improvement first described, as the first step to which I should recommend the adoption of this third plan; in the strong hope that such would be the increase of trade in Wexford, as a port, from the greater commercial facilities that would be afforded by the execution of what is now proposed, that whatever may be found necessary to effect the most perfect condition of the harbour, might hereafter be completed.

As I have entered into calculations to prove the amount of injury to the entrance from the present state of the harbour, it is necessary that I should state the data, with the inferences which I have drawn from them, upon which I have calculated and adopted the area of the proposed new basin.

The space intended to be left for the reception of the tide, outside the site of the proposed new bridge, is 5·64 square miles. This, added to what is above it to Enniscorthy, would afford a total tide-basin of nine square miles.

The maximum rise of a spring-tide would probably be five feet over the whole of this area. The cubical quantity to be discharged would then be 1,254,528,000 feet, for the delivery of which (in six hours, and preserving the same sectional area of 14,000 square feet), as in the former calculations, a mean velocity would be required of 14,934 feet per hour, or four feet two inches per second. Reducing this to the velocity due at the bottom will give three feet seven inches per second, and taking one-sixth of the latter for the disturbing effect produced upon the water under low-water level, it appears that the action on the bottom of the harbour's mouth would be seven-and-a-quarter inches per second, when the tide alone would have to pass through.

Adding the waters of inland floods from the Slaney and other rivers to those of a spring tide, the amount will be—

Spring-tide . . .	1,254,528,000	cubic feet.
Inland floods . . .	340,736,000	„ „
Total . .	1,595,264,000	„ „

requiring for their exit, in the six hours of an ebb tide, a mean velocity of 18,991 per hour, or five feet three inches per second; and assuming, as before, that one-sixth of the velocity which this would produce at the bed of a stream is equivalent to the disturbing power below low water, the maximum with which the water would move along the bottom, at the entrance to the harbour, would be nine-and-a-quarter inches per second, which is very little more than what would lift sand as coarse as linseed.

Thus sufficient velocity would be afforded to keep the entrance clear of sand, while no danger need be apprehended of its tearing up the bottom.

It might, perhaps, be said, that, during neap tides, there would be too great a reduction of the scouring power.

Before I enter upon this part of the subject, I should premise that I have kept in view the improvement of the harbour, as a primary object, in accordance with your intentions; and have contemplated the reclamation of the mud lands only so far as it may be made the means of carrying out the former measure in the best manner. The lines of the embankments have therefore been laid out irrespective of any desire to increase the area of land, to be gained, in the slightest degree that could be detrimental to the harbour. On the contrary, the desire has been to afford an ample tidal basin.

The extent of mud lands, covered at high water by neap tides, is about seven square miles.

Within the proposed new basin, two of these are included, off which (they being on the borders of the present low-water channel, and covered to the greatest depth) the tides flow with the best effect.

The remaining five square miles are covered to a depth of, at most, nine inches, and are therefore equal to 3·75 square miles—say four miles—covered one foot deep.

If then the area of the two square miles, which it is intended to include in the new basin, be excavated only two feet below the present surface, full compensation would be afforded for the water that would be shut off: but I have little doubt that the whole of the new basin will be hereafter lowered to the same depth as is proposed for the new sailing course, besides which it is intended to deepen the Slaney.

The proposed plan, therefore, provides the means for greatly enlarging the supply of water during neap tides, if any such should be required; and, what is of still greater consequence, the effective power of this large body would be increased in a degree more than proportionate to the increase of quantity, by the collection and direction of its strength in a proper manner, instead of allowing it, as at present, to spread thinly over the almost level surface of the mud lands.

With regard to widening the mouth of the harbour, I should recommend its being done. But here I must remark, that when I proposed deepening the Slaney, as an adjunct to the improvement of the harbour, and also when I propose to widen the mouth of the harbour, I do so, not with a view to their being undertaken at the cost of the Company, but as measures, in aid of which I conceive a fair claim may be made for a grant, similar to what was allowed by Government for the river Shannon. I also consider that a portion of the expense of the proposed free bridge should be defrayed by county taxation.

As you, however, are determined to carry the improvements as far as your probable income will fairly permit, I have been obliged to curtail my plans, and among others, to abandon the increased width of the entrance that I at first contemplated, in order to limit the expense of the works to such amount as the reclamation of the mud lands would be likely to afford you a fair return for.

This widening could be effected at any time hereafter, and, in doing so, the point of the "Raven" should be cut off so that the northern side of the entrance should approach, as nearly as possible, to a line parallel to the curve on the inside of Rosslare Point, and thus lead into the North Bay. The piling of "Dogger Bank" could be continued to the north-east so as to form the boundary of this new channel on the south-east.

The formation of a permanent island, on the site of this bank, besides other advantages, would afford shelter in the harbour from south to south-east winds; and considering the large extent of surface over which the winds now exert their influence, this shelter would be much increased by the erection of the embankments to enclose the new basin, particularly when a less area would be exposed

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to the action of storms. The shape of the northern embankment, stretching so far south, in front of the town, would be another source of protection to vessels lying alongside the quays.

The works that I have laid down, on the plan proposing to retain and improve the present entrance and basin, can be safely executed within your proposed capital, and the value of the mud lands, when reclaimed, would, I think, afford a fair return from the expenditure.

I have, &c.,
JAMES B. FARRELL.

To the Provisional Committee,
&c. &c.

KILMORE.

No. 46.
Evidence taken on the 6th Sept., 1845.

No. 46.

KILMORE.

Examining Comissioner—Captain WASHINGTON, R.N., F.R.S., assisted by Captain FRAZER, of H.M.S. *Lucifer.*

Present:—Sir THOMAS ESMONDE, Bart., M.P.; JOHN ROWE, J.P.; JAMES TALBOT, J.P.; JOHN HOWLIN, J.P.; Captain E. RICHARDS, R.N. and J.P., JOHN E. REDMOND, RICHARD ALLEN, JOHN GREENE, FRANCIS HARPER, J. KENSELAH, DENIS KENSELAH, R. W. RYAN, ROBERT SPARROW, Wexford Harbour Commissioners; JAMES B. FARRELL, C.E., County Surveyor; Rev. JAMES WALSH, P.P.; HENRY HATTON; Lieutenant STERNE, R.N.; Dr. A. FURLONG; Lieutenant SEWELL, R.N.: EDWARD MEADOWES, Esq., &c. &c.

[*Drawings and plans of the new pier, prepared by Mr. Frazer, C.E., under direction of the Board of Works, were laid on the table.*]

The following witnesses were examined:—

HENRY HATTON, Esq.—Has been in the habit of visiting Kilmore every year during the last ten years; heard repeated complaints of want of a safety harbour for the fishing-boats; is well acquainted with the fishermen, who exceed 200 in number, and are industrious, hard-working, but very poor; in consequence of several accidents, it was suggested by the Rev. James Walsh, the priest of the parish, Dr. Furlong, and others, that the fishermen should try to build a pier for themselves; to which many of them subscribed in money, and others in labour, to the amount of 75*l*. In the meantime 237*l*. were received in contributions from the kindness of the neighbouring gentry. All this money had been expended, and the sum of 500*l*. was still wanting to complete it, for which the fishermen trusted to the liberality of the proprietors of the land, and other benevolent individuals. He lamented that stone had been taken by farmers and others from Forlorn Point, half a mile to the westward, which caused much swell to come into the harbour, and did great damage.

The COMMISSIONER remarked that the right of the soil between high and low water-marks belonged to the Crown; and that no one was entitled to remove stones from the beach that could cause damage to a neighbouring harbour; and he appealed to the good feeling of the farmers and others in the vicinity whether, when they know that a few poor fishermen were struggling and doing their utmost to build themselves a small safety harbour, they would heedlessly ruin it by continuing this practice. If stone were wanted, it might be taken from the rocks to the eastward of the pier, but not from Crossfarnogue Point.

Mr. EDWARD MEADOWES—Has resided thirty years at Kilmore; has seen much danger for want of a pier not only to the fishing-boats, but also from wrecks of larger vessels: in 1841 four boats were wrecked at once, which would not have happened had a pier existed. No year passes without one or more wrecks on Ballyteigue Burrow. The Brandy Rocks in the offing are very dangerous; and when the Coningbeg light becomes fixed they will lie right in the track from that light to the Tuskar; is of opinion that a buoy ought to be placed on them. The Fishery Board in Dublin very liberally contributes two-thirds of the whole sum required as soon as one-third is subscribed; thus if 700*l*. could be raised they would make it up to 2,000*l*., which would be ample to complete the pier; is of opinion that by the Grand Jury Act, the county might be taxed to the amount of 200*l*. for fishing purposes; and thinks it would be cheerfully paid when it was known how conscientiously it would be expended in carrying out this work. The poor labourers of the district acted most disinterestedly, for they gave a considerable portion of their labour free.

JOHN WALSH, fisherman—Is 68 years old; has lived all his life at Kilmore, and has fished along the whole coast; there is abundance of fish close in-shore, and still more on the Nymph Bank near at hand; which they cannot venture to go to because the small size of the present harbour will not admit of their maintaining a trawling-vessel fit to go out there. No part of the coast is more in want of a good harbour; and if they had it, the whole county might be supplied with fresh and cheap fish. Has witnessed many sad wrecks for want of a pier; and had a son drowned in trying to save some boats from destruction. Agrees with all former witnesses that a buoy on the Brandy Rocks is much wanted, as also upon Mullock's Rocks: the owner of the property gave no support whatever to the undertaking, nor did he even reply to their application.

JOHN WALSH.—At the commencement of the undertaking the labourers gave 1*s*. per day each in labour until 40*l*. was made up.

J. E. REDMOND, Esq.—I will give 5*l*. at present, probably more hereafter towards building the pier.

Lieutenant SEWELL, R.N., Commander of the Coast Guard at Kilmore.—Nineteen first-class fishing-boats, and 34 open boats and cots are registered, employing 200 fishermen; and they and their families comprise from 800 to 1,000 persons entirely dependent upon the fishing for subsistence. Besides these, upwards of 30 trawlers from Dunmore could often land their fish here were there a harbour they could run for.

Rev. JAMES WALSH corroborated the whole of the above evidence; and in addition said, that no greater boon could be bestowed on this part of the coast than the extension of the present pier, and that he had every hope it would be done.

The COMMISSIONER said he could not close the present inquiry without expressing his admiration of the exertions of the poor fishermen, who had voluntarily given their daily labours to aid in the erection of this pier, nor could he deny himself the gratification of thanking the Rev. Mr. Walsh for his persevering exertions in soliciting contributions of the wealthy to assist their poorer brethren. He begged to subscribe his mite, and he felt it a privilege to be allowed to take a share in such a good work: he felt sure that when the proceedings of that day became known, and it was generally understood that if 300*l.* could be raised in the course of this winter and the same in the winter of 1846, that an excellent safety harbour at Kilmore could be completed, the noblemen and gentlemen of the county of Wexford would not allow the want of so trifling a sum to be an obstacle, especially when they considered that by granting this boon they would not only supply their own tables with the luxuries to which they are entitled, but reward an industrious and hard-working class of men, and enable them to procure abundance of cheap and wholesome food for their wives and children, without that risk of life that at present attends their occupation.

APPENDIX B.

KILMORE.

No. 46.

Evidence taken on the 6th Sept., 1845.

No. 47.

An Account of Vessels Wrecked on the immediate Coast of Kilmore within the last Ten Years

Submitted by Dr. A. FURLONG.

No. 47.
Account of Wrecks on the Coast.

Date.	Name.	Cargo.	Rig.	Remarks.
1834				
Jan. 10.	Shubenacadie . . .	Cotton . .	Brig.	
Dec. 18.	Waterwitch. . . .	,, . .	Steamer .	Seven lives lost; remainder of crew and passengers saved by the exertions of the fishermen.
1835				
Sept. 30.	Frances	Oil	..	Of Newfoundland.
1836	——	Logwood .	Brig.	
,,	Maria	Wine . .		
,,	Betsey Miller . . .	Sulphur . .		
1837	——	Apples . .	Schooner.	
1838				
Nov. 28.	Robert Noble . . .	Flour . .	..	From Cork.
,, 29.	Belma.	Timber . .	..	Mate drowned; crew saved by Captain Manby's apparatus.
1839				
Sept. 5.	Portuguese Schooner .	Fruit. . .	..	Three boys drowned.
1839	Francis.	Grain. . .	..	On small Island.
Jan. 21	Eliza and Ahhy . .	Turpentine .		
1840				
Feb. 18.	——	Slates . .	Sloop.	
1842				
Jan. 25.	A Maltese Ship. . .	..	..	Four lives lost.
Dec. 15.	Vermont	..	Ship.	
,, 24.	Alfred	Brandy . .	Brig . .	Captain drowned.
1843	Santon	General.	Barque.	

Ten vessels were piloted out of the Bay within ten years by the fishermen.

No. 48.

BALLYTEIGUE LOUGH.

Capt. VETCH, R.E., *on the Drainage of the Lough of Ballyteigue.*

BALLYTEIGUE

No. 48.

Vetch on the Drainage of Ballyteigue Lough.

THIS lake is also situated on the south coast of the county of Wexford, and extends along the coast nearly six miles. Its extreme length, in an east and west direction, is six miles and three-eighths, and its greatest extent, in a north and south direction, is three miles and a half. The form of this lake is very irregular, varying in width from 150 yards to seven-eighths of a mile, with a general resemblance in its figure to the letter L. On the south the lake is bounded by sand-hills or burrows, which separate it from the sea, similar to those already described, but at this lake the burrows are more elevated, and occupy greater width than usual; they are also well clothed with sand-plants, and are inhabited by multitudes of rabbits. Notwithstanding the width and height of the sand-hills, the sea has breached across them in several places to an aggregate extent in length of about 400 yards. These breaches, however, might easily be secured, and, with a little care, the burrows might be rendered an efficient barrier against any inroad of the sea; but, in fact, in their present state, no water passes through them, except in severe gales of wind at high water. The shores of this lake, on the land side, are chiefly composed of banks of clay and marsh land, but at the east end some micaceous rocks appear, and these also form the coast at Forlorn Point or Crossfarnogue.

The entire surface of the lake, as covered by high water at spring tides, amounts to 2,206 English statute acres. The western end of this lake towards its mouth is very narrow, and chiefly occupied by the channel, through which the tide rushes with great force, and with great waste of the land near the entrance, where, I was informed by the coast-guard, that it was corroding westward at the rate of eight feet per annum. At Forlorn Point I was also informed that the sea was encroaching on the land, where the shore was composed of clay, at the rate of one foot per annum.

For the sake of a more ready description, I shall divide this lake into four portions:—

1st. The West portion.
2nd. The Middle ditto.
3rd. The East portion.
4th. The North ditto.

The West Portion is one mile and five-eighths long, and contains 130 acres; of which 72½ acres consist of channel, or deep water; and for reasons already stated, I would not recommend the embankment of this portion.

The Middle Portion.—This is still narrow in respect to its length, but comprises a branch of some extent, running northwards to Duncormack Bridge; this portion is two miles long, and contains

Appendix B.

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410 English statute acres, of which 140 are uncovered at low water; but I expect, that partly by drainage, and partly by silting up, the whole 410 acres might be made available for tillage; and I recommend that this portion be included within the embankment, having its drainage westwards, while the remainder of the lake will drain eastward; the water shed of the lake dividing this portion from the east portion.

The East Portion.—This is the largest and most important part of the lake, extending two miles and three quarters east and west, and one mile and three quarters north and south, and containing 1,199 English statute acres, and without any water which may not be drained.

The North Portion, called also the Lake of Broadwater, extends north and south one mile and three quarters, and east and west one mile and five-eighths. The greater part of this portion is under water at ebb of tide; but I am informed that it admits of drainage. The total acreage of this portion amounts to 467, whereof, at present, 276¼ acres are under water at ebb tide; but if we suppose these admit of drainage, the quantity of land to be embanked, and rendered available for tillage would stand as follows:—

West Portion	0
Middle do.	410
East do.	1,199
North do.	467
English statute acres	2,076

In order to reclaim these acres, I propose to run an embankment across the lake one mile and five-eighths above the entrance, where the breadth of the lake is only 220 yards, which short embankment will complete the barrier against the tides; but the difficulty in respect to reclaiming the land in this lake, is similar to that in Lady Island and Tacumshin Lakes, viz. to find a secure mode of discharging the water into the sea. Fortunately, in this case, there is one place at the eastern extremity, where the shore is composed of rocks, and I gladly avail myself of that circumstance, upon which to found my plan of drainage, which is as follows:—

Through the rocks forming the shore, at the above-mentioned place, I propose to cut a channel down to the level of low water at spring tides, to continue this cut under the burrows by means of a tunnel, and then to direct a main drain straight into the Lake of Broadwater, or North Portion, with two branches directed across what has been called the East Portion, which I conceive would effect all the ends required; and it happens fortunately that a rocky shore occurs in one point, and where it is especially convenient for effecting the object in view.

James Vetch.

No. 49.
Russell, on the proposed Drainage of Ballyteigue Lough.

No. 49.

Report by Mr. E. Russell, C.E., *on the Proposed Drainage of Ballyteigue Lough.*

31*st December*, 1843.

Ballyteigue Lough is situated on the south coast of the county of Wexford, along which it extends in an east and west direction for a distance of five miles and a half; its extreme length in a north and south direction is three miles three furlongs; in width it varies from about 30 perches to nearly one mile. It is of a peculiar form, having a very narrow entrance from the sea, with a long narrow channel that suddenly expands into a wide inland lough or slob, as more particularly described in the accompanying map.

The southern boundary of this lough is a great range of sand hills, called the Burrow of Ballyteigue, which separates it from the sea, and extends for nearly six miles in length, from Crossfarnogue, or Forlorn Point (the eastern extremity), to the bar of Lough at the western extremity; there the tidal waters ebb and flow through a very narrow channel in their passage to and from the lough or mud lands; and there the waters of the various rivers or streams which empty themselves into the lough are discharged.

The range of sand hills above adverted to form the sea-ward barrier to the lough; they are, for the greater part, well clothed with bent, which preserves the surface from the destructive effects of severe gales.* This barrier varies in width from about 20 to 120 perches; and also in altitude,—for whilst a portion rises to a height of 60 feet above the level of the sea, some of the waters of very high tides, when accompanied by severe gales, pass over other portions, through which breaches to a limited extent now appear; these, however, could be secured at a small expense, and rendered a permanent and secure barrier against any inroad of the sea.

The northern shore of the lough, from the bar to the junction of the Duncormick river, is high clay land; from thence through the lands of Cull (which are principally low, and liable to floods), the shore is for the most part sand, overlaying, to a considerable depth, bog and clay; through the lands of Park and Killag, the sand disappears, and the clay land extends to the verge of the lake, and so continues to near Ring's Nook, where a considerable tract of low marshy land, subject to flood, stretches out for a considerable distance, extending through part of Killag, Richfield, Riesk, and Pembrokestown, narrowing towards the head of the lake, or mud lands, and so continues in a northerly direction by the Muchtown river, as far as the mill, passing through the lands of Kilcowan and Hooks.

The floods extend over the lands adjoining the Baldwinstown and Bridgetown rivers, part of the lands of Yoletown, New House, Castletone, and Bridgetown, reaching as far as Ballycross and Ballyharty, where the high lands commence and continue, with some intermixed pieces of low land, along the eastern shore of the lake to its termination at Crossfarnogue.

The whole of the lands on the borders of the Ballyteigue Lough, which are liable to frequent and injurious floods, are represented by a purple tint on the annexed map, and contain, by a calculation made from the Ordnance Survey, 609 statute, or 376 Irish acres.

The lands adjoining the above, represented by a green tint on plan, containing 418 statute, or 258 Irish acres, although not liable to be actually flooded or covered with water, are so saturated as to be materially injured, and are, for want of sufficient fall, deprived of the advantages which might be conferred by under-drainage.

The lands represented by a yellow tint on the plan, containing 318 statute, or 198 Irish acres, although not injured to the same extent as the last, are, from their low situation, at present deprived of a sufficient out-fall for drainage, and have been occasionally damaged by high tides overflowing the banks. Their value would therefore be considerably enhanced by the contemplated improvements, which would free them from risk, and afford a lower level for the out-fall of the drainage waters.

The sum of these several quantities, taken together, amounts to 1345 statute, or 830 Irish acres, the drainage and improvement of which *depend solely on the exclusion* of the tidal waters from Ballyteigue mud lands, and the drainage thereof; indeed, both these works are so intimately connected as not to admit of separation, and should therefore be undertaken as one project.

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* There are some portions of it, however, which it would be indispensable to have planted with bent, to prevent the sands from being blown in upon the reclaimed land.

APPENDIX B.

BALLYTEIGUE.

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Russell, on the proposed Drainage of Ballyteigue Lough.

The entire surface of Ballyteigue Lough, including the strait covered at high water, contains 2,200 statute, or 1,358 Irish acres; of this quantity it is proposed to enclose 1,630 statute, or 1,006 Irish acres, the surface of which consists of beds of mud and rich alluvial deposits, with the exception of about 170 statute, or 105 Irish acres of sandy beach along the Burrow, south and west of Inuish island; of the whole about 130 statute acres are occupied by the channel, and part of the Broad-water, too low to be drained.

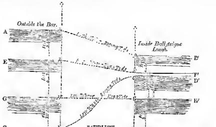
The total quantity of land, therefore, to be drained, reclaimed, and improved, amounts to 2,845 statute acres.

Ballyteigue Lough appears to have undergone several changes in a geological point of view. Bog and clay can be traced in parts at no great depth underneath the sand, which appears to form the substratum of a great portion of the slob; this is a proof that the space now occupied by the lough was originally a portion of the land on which *the sea encroached*, and eventually overran, until the formation of the sand hills shut it out again, except by the narrow strait and channel referred to. The lough now appears to be undergoing another change—in fact, reverting to its assumed original state of land above the level of the sea. This process is produced by the several rivers which enter the lough carrying down from the interior of the country the alluvium which is held in suspension in their waters, until they spread over the widely extended surface of the lough, and there deposit it, thereby gradually raising the surface of the submerged or mud lands, until they are now scarcely covered at high water neap tides, and are altogether dry at low water, with the exception of a portion above Ring's Nook, called the Broad-water, and the channel running seaward.

The minimum breadth of this channel is near its entrance into the sea, at the "Bar of Lough," where it is 110 yards wide at high water, and only 30 yards at low water.

The formation of Ballyteigue Lough, strait, and entrance, produces extraordinary effects on the tides; and as these effects produce the evils which it is now proposed to remedy, it becomes necessary to describe and consider them.

The annexed diagram shows at one view the relative levels of high and low water, of spring and neap tides, *within the lough* and *outside the bar* respectively.



In the above figure, AB, CD, represent the levels of high and low water spring tide, immediately outside the bar of Ballyteigue Lough respectively, and A'B', C'D', the corresponding levels of the same tide in the lough above Ring's Nook; EF, GH, the levels of high and low water neap tide immediately outside the bar, and E'F', G'H', the corresponding levels of the same tide, above Ring's Nook respectively.

The difference of level CA between the rise and fall of ordinary spring tides immediately outside the lough, is from 10 to 11 feet, and of extraordinary springs, 12 feet: whilst the difference of level C'A' of the corresponding tides in Ballyteigue Lough, above Ring's Nook, does not amount to 3 feet.

In neap tides, immediately outside the bar, the difference of level GE between high and low water, is from 4 to 5 feet; whilst the difference of level G'E' of the corresponding tide in Ballyteigue Lough, does not amount to 3 feet. By an inspection of the diagram, it will be seen that the *high-water mark* of neap tides within the lough, and *low-water mark of spring tides* at the same place, are nearly on the same level.

And from the above figure it will also appear, that in a spring tide, the difference of level between high-water mark without the bar, and high water of the same tide above Ring's Nook in Ballyteigue Lough, is 2·80 feet, the height of the former being represented by CA = 11 feet, and the latter represented by XA' = 8·20 feet; and low water of spring tides without the bar falls 6 feet below the level of low water of the same tide, within the lough above Ring's Nook.

In neap tides, high water without the bar is 1·30 feet above the level of high water of the same tide within the lough above Ring's Nook, whilst low water at both these places is on the same level.

The difference between the time of high water immediately without the bar, and that of high water in Ballyteigue Lough above Ring's Nook, is 2 hours and 50 minutes, and there is also an equal difference between the times of low water at those places; this difference of time gradually diminishes as you approach from Ring's Nook towards the bar.

This state of things leads to a fact that may appear somewhat paradoxical—namely, that long after the tide begins to fall at the bar, there is a strong current running through the narrow channel towards Ballyteigue Lough.

By an observation made at the Water-Guard Watch-House, which is about 200 yards above the mouth of the channel, it was found that the current was running in with a velocity of 4 feet per second, although the tide, outside, had reached its maximum height, and was actually descending at the time; and the current continued to run in through the channel, towards the lough, for nearly an hour after the tide outside reached its maximum height; during this time the water in the channel had fallen nearly 12 inches.

The differences between the heights of the tide in Ballyteigue Lough, when compared with the corresponding heights outside the bar, and the differences between the times of high and low water at the former place, when compared with the corresponding times at the latter, arise from the one cause, namely, the contracted width of the long channel through which the great extent of Ballyteigue Lough is filled or emptied by the tide.

The tide in the lough flows little more than five hours, whilst it ebbs for nearly seven hours, chiefly from the causes already stated, and on account of the quantity of water which runs into the lough from the surrounding country.

It will appear from the foregoing diagram, and the facts now stated, that within the Lough of Ballyteigue the level of low-water spring tides is not only higher than that of low water neaps, but nearly on the same level with that of high-water neaps. At the entrance of the channel, spring tides rise to their natural level, and flow through the channel into the lough with great rapidity, meeting the drainage waters of the country which flow down by the rivers; the waters thus accumulate in the Broad lough, and are obstructed in their passage out by the narrowness of the channel; through it, however, they continue to run until they are met by the next ascending tide; by this time only a portion of the water is discharged which accumulated during the rise of the former tide; and so each succeeding spring tide increases the accumulation, raising the water to so high a level within the lough as to prevent not only the drainage of the adjacent low lands, but in times of rain to cover the entire of 609 acres of valuable land adjacent to the lough.

It also appears that the best, and at some seasons the only power of drainage afforded to the low grounds adjacent to Ballyteigue Lough, is during neap tides, although it is contrary to what is usually the case, spring tides being in general the most favourable for the drainage of such lands; but here the neap tides, unaided by freshwater floods, do not rise much higher than the general level of the slob lands, and consequently, by not overspreading the great expanse of the lough, are enabled to ebb to a lower level than springs.

It should also be remarked, that the concurrence of a flood in the rivers, with the high water of any tide, produces flooding and injury to the adjacent low grounds; and finally it is found, as might indeed be anticipated from all the foregoing facts, that the lough, apart from the strait, partakes more of the character of an inland fresh water lake than a part of the sea, the water in most seasons being little more than brackish, and in the upper part nearly fresh, whilst the vegetable productions are such as are usually found in brackish waters.

Navigation of Estuary.

The strait and channel of Ballyteigue Lough are only navigable to a certain extent for small-class vessels trading with coal for the use of the immediate neighbourhood; but as Kilmore and Bannow Bay are only a few miles distant from Ballyteigue, and are trading places for coal vessels, any trade in the way of shipping carried on over the Bar of Lough is but trifling, and must involve considerable difficulty and risk, from the circumstance of there being only about 18 inches or 2 feet in depth of water in the navigation channel over the bar at low water; and, moreover, this channel is liable to shift at every storm, which must add to the difficulty and danger of entering it; indeed, so much so, that it would be ruinous to strangers to attempt it, as it can only be entered at high water, under favourable circumstances of wind and weather, by those acquainted with the navigation; it is therefore altogether useless, even as a temporary asylum harbour. As a proof of the difficulty, a circumstance which I witnessed may be mentioned. A coal vessel called "The Seven Brothers," of Tenby, drawing only 7 feet of water, was unable to get out over the bar at high water on the 22d of May last, in moderate weather. And although Ballteigue estuary is in the neighbourhood of valuable fishing grounds, on a coast where harbours are much required, there are only two or three boats of any kind which belong to it.

The highest point to which coal vessels run is Lacken, about a mile and a half up from the Bar of Lough; but, however unimportant the navigation of the channel may be, yet it is a navigation, and should be deemed by the engineer a prominent feature for consideration, prior to adopting a plan for the embankment and reclamation of the slob or mud lands of Ballyteigue, which would be likely to have an influence on it.

The difference in the times of the ebbing and flowing of the tide at the Broadwater and outside the Bar of Lough, is, as before mentioned, 2 hours and 50 minutes; this produces results on the navigation which it would be desirable to bear in mind—namely, that the flood tide from sea meets the ebb tide from the lough, when its effects would be most powerful on the bar; its momentum is thereby destroyed, and the scouring effects neutralized: and so long as the tidal waters are allowed to flow over the extended surface of Ballyteigue Lough, so long will such irregularity in the ebb and flow of the tide continue.

If the waters were confined to a space sufficient to ensure the regularity of the ebbing and flowing of the tide within its due course, that is, in equal times, its scouring properties would have force and effect, which it is now deprived of;* care, however, should be taken, that the whole available part of the tide be admitted through the channel; and as regards navigation, this consideration raises the question hereinafter mentioned, as to the proper site for the embankment.

It is also to be borne in mind that the tendency to form a bar here does not, as in many other cases, arise so much from the deposits carried down by the discharging rivers, as from the accumulation of shingle and sand on the coast. It is presumed, however, that a state of tides, which during springs prevents the effective discharge and scouring power of the ebb tide from the lough, by the meeting of the flood nearly at half tide, must be detrimental in their tendency on the bar.

Drainage.

The extent of the catchment basin, or district of country which discharges its drainage waters into Ballyteigue Lough, eastward of the Duncormick river, including the area of the lough itself, is, as has been ascertained from the Ordnance Survey, 26,752 acres, or 41·8 square miles.

This district of country embraces a great variety of surface; that in the immediate vicinity of the lough is flat and low, whilst the northern extremity, in which is included a small portion of the Forth mountain, ascends to an elevation of 500 feet above the sea; but the central part, comprising the greatest extent, is moderately high and undulating.

The greater portion of this tract of country is clay land, much cultivated and sub-divided, very little of it of a porous nature; and consequently in time of rain the waters are very rapidly discharged off its surface into the lough and low lands under consideration.

Three-fourths of the waters of this district are discharged into the lough by three rivers—namely, the Bridgetown, Baldwinstown, and Muchtown rivers.

The Bridgetown river, about six miles in length, discharges the drainage waters of 7,435 acres; the Baldwinstown river, about five miles in length, the drainage waters of 5,879 acres; and the Muchtown river, about eight miles in length, the drainage waters of 6,938 acres; making together 20,252 acres. The remaining portion of the catchment basin, containing 6,500 acres, embraces the lough itself, and the lands adjacent thereto, which drain immediately into it from the surface and by minor drains.

The Duncormick river, about seven miles in length, discharges the drainage waters of 12,600 acres into the lower reach or strait of Ballyteigue, so that the drainage waters of 39,352 acres run into the sea over the Bar of Lough; the latter river, from the contiguity of its mouth to the bar, uniformly discharges its waters with the outgoing tide.

The waters of the three first-named rivers run into the Broad lough and slob, overspreading the surface thereof, and, in conjunction with, or backed up by, the tidal waters, are there accumulated, to the injury of the adjoining low ground and the prevention of its improvement.

It is clear, that if the entire drainage waters carried down by the Bridgetown, Baldwinstown, and Muchtown rivers, were discharged with the Duncormick river into the strait or channel below the Broad lough of Ballyteigue, and excluded with those of the tide from this lough, they would very considerably increase the scour at the bar, and probably tend to improve the navigation, or at least to keep it fully as effective as it now is.

The following table exhibits at one view the extent of the district of country from which each of the following rivers discharges the drainage waters into that part of the lough and low lands proposed to be relieved, with the maximum quantity of water supplied in 24 hours, as deduced from the registries of the fall of rain heretofore kept in this country, which show a height of 1·5 inches over the surface, four-tenths of which is usually assumed to be discharged into the sea by the adjacent streams and rivers.

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* It is the generally received opinion, and admitted by eminent engineers, that whatever conduces to ensure the regular ebb and flow of the tide in its due time and course, must tend to improve the navigation of rivers obstructed by bars, as one of the principal causes of the accumulation of sand or detritus is the obstruction caused by the meeting of the incoming and outgoing tides, and that consequently there is a limit to the space which it would be desirable to fill and empty each tide, beyond which limit all additional space is rather injurious than otherwise.

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Name of river.	Extent of catchment basin in statute acres.	Maximum quantity of water to be carried off by the rivers in 24 hours.
		Cubic feet.
No. 1, Bridgetown . . .	7,435	16,193,430
„ 2, Baldwinstown . .	5,879	12,704,462
„ 3, Muchtown . . .	6,938	15,110,964
„ 4, Ballyteigue lough and adjacent lands . .	6,500	14,157,000
Total . .	26,732	58,265,856

The discharge of the above quantity, as a maximum, in one day or 24 hours, should be provided for, in consequence of the entire of it running at present into the lough or slob lands. In the first instance, I conjectured that it might be carried off from thence by a system of sluices, but further investigation has led me to form a different opinion.

It has been ascertained from the levels taken, and from observations made on the rise and fall of the tide at Ballyteigue, that the greatest height at which the waters could remain inside the slob for any length of time, without an injury thereto, is 23·86 inches, equal to 1·99 feet above the level of low-water neap tides, which would be 14·54 inches below the general level of the slob lands.

The time for discharge by the sluices would be 2 hours 45 minutes, from low-water neap tide, until the tide would ascend to 1·99 feet above low water, and about an equal time during the descending tide. This would give 5 hours 30 minutes (theoretically) for discharge by the sluices; but the sluices will not become effective immediately on the falling tide reaching the level of the water in the drains of the slob, and some time will consequently be lost both on the descending and ascending tide; it will also be borne in mind, that the discharge would be very trifling for a considerable portion of the time stated for each tide, *i.e.*, whilst the tidal and slob waters are nearly on the same level, therefore, the time for effective discharge may be fairly taken at 4 hours 30 minutes in the 12 hours, or 9 hours' discharge in the 24 hours.

It is unnecessary to enter into minute calculations, or stop to reason on points which are in themselves of small importance, when compared with the circumstance of the sluices, however extensive, remaining inactive for nearly 15 hours in the 24; and as the maximum rate of supply from the catchment basin, during the continuance of 24 hours, is 2,427,744 cubical feet of water per hour, the quantity supplied during the 15 hours that the sluices remain inactive must be 2,427,744 × 15 = 36,416,160 cubical feet—a quantity so large that it is capable of overspreading to a depth of upwards of six inches the surface proposed to be enclosed.

If the annual quantity of drainage waters was divided equally over the 365 days of the year, it would not be a difficult matter to find means for its discharge; but it is necessary to provide for sudden and maximum falls of rain, and particularly so, when, as is well known, the greater part of a month's rain has fallen in a few days, and often in 24 hours; add to this that the recorded falls of rain show in this country, that the greatest quantity usually falls in the months of July and August, when the crops are in that state that injury from floods would be greatest.* I may also remark, supposing the sluices to be placed at Crossfarnogue or any other exposed situation, that if by the action of the sea during heavy gales, or any other cause, the power of one or more of them became defective, or required repair, there would then remain a much larger quantity undischarged in the slob. Indeed, the risk attendant on the discharge of so large a quantity by sluices or even assisted by any moderate pumping machinery, and the ruinous consequences attendant on an overflow of the slob lands, which, perhaps, might be in cultivation at the time, are of themselves sufficient reasons for abandoning the project of discharging the whole of the waters which now run into the slob by a system of sluices alone.

It also appears to me difficult to preserve self-acting sluice-gates of considerable width (such as would be required at Crossfarnogue) in a perfect state of repair, in exposed situations, particularly as they would in some degree be subjected to the wash of the sea, and in southerly gales the tides do not fall to their natural level, and are consequently, under such circumstances, much less favourable to the discharge of the water by sluices.

There also appears to be considerable difficulty in the making of any cut near the great sand hills at Crossfarnogue; for, if an open cut were attempted, it would be soon closed by the blowing and shifting of the sands; and arching or tunnelling through the rock there, to an extent sufficient to afford the waterway that would be required (if the drainage waters were to be discharged by sluices) through a length of 1,650 feet (the breadth of this point of land), would be exceedingly expensive. Under all the circumstances, and after mature consideration, I have abandoned the project of discharging through sluices the drainage waters carried down by the Bridgetown, Baldwinstown, and Muchtown rivers.

The plan which I propose for the consideration of the Commissioners, and with their approval to adopt for the drainage of the flooded lands, and the embankment and reclamation of the Ballyteigue Lough and mud lands, is as follows:—

Proposed Improvements.

It is proposed to construct a new river course from Mulrankin mill, situate above Bridgetown, taking up the waters of that river at such an elevation, that by adopting a contour line which will take in the waters of the Baldwinstown and Muchtown rivers, a uniform rate of fall or inclination of 1 foot per mile, under the least favourable circumstances, may be obtained to the lower reach of the Duncormick river, at Seafield, where the drainage waters of the 20,252 acres of the district of country which now pours its waters into the slob lands of Ballyteigue by the Bridgetown, Baldwinstown, and Muchtown rivers, will be discharged, leaving only the drainage waters of 6,500 acres to be discharged though these slob lands by sluices.†

It is likewise proposed to shut out the tidal waters from Ballyteigue Lough, by an embankment at a point 128 perches above Cull Island, extending from the land at the north side of the strait, to the burrow or sand hills on the south side from C to D (see diagram map annexed), which is a distance of 1,183 feet; its greatest height at crossing the present channel will be 15 feet, and average height 11 feet, or 3 feet over high-water spring tides; the extent enclosed by this embankment will amount to 1,630 statute acres, whilst the flooded and injured lands amount to 1,345 acres, making a total of 2,975 statute acres.

In selecting this site for the embankment, I have been chiefly influenced by two considerations:—1st. The foundation and convenience of materials. 2nd. To place it so as not to exclude any portion of the

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* If it be asserted that these very heavy falls of rain are not of frequent occurrence, still we should not forget that the loss of one crop would be greater than any additional expense now to be incurred for its prevention, and that the effect which the sudden thawing of snow will have in pouring down floods will be at least equal to the heaviest falls of rain.

† This new river course will, under most circumstances, be navigable for small class boats up to Bridgetown.

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tidal waters, which appears to me to be available for the purposes of navigation, and as far as possible to ensure the regular ebb and flow of the tide within its due course.

This situation is well sheltered by Cull Island, and the channel, where it is proposed to be crossed by the embankment, is favourable for that purpose.

As regards its position with reference to the quantum of tide water to be admitted, or basin to be filled, I reason as follows:—

Taking the width of the channel at low-water spring tide to be 130 feet, and at high-water spring tide 300 feet, and the total rise of tide at the mouth of the channel to be 11 feet, and the extent of surface to be 2,200, less by 1.630 acres to be enclosed, will leave 570 statute acres, between the Bar of Lough and the proposed embankment above Cull Island, to be covered to an average depth of 5 feet at every spring tide.

Then the number of cubic feet of water will be found to be 570 × 43,560 × 5 = 12,414 600 cubic feet. Supposing, as at present, the tide to run in only for five hours, and the mean sectional area to be, as I assume it, 1,237 feet, the velocity required to fill the space which is to be left open to the ebb and flow of the tide outside the proposed embankment, will be 5·57 feet per second. As the tide will then be shut out from the Broad lough, and confined to the narrow strait and channel, the cause of the irregularity or difference in the time of its ebbing and flowing will be in a great measure, if not altogether, removed (as explained in the foregoing part of this report), and the time may therefore be calculated as six hours for flood and six hours for ebb; the mean velocity would in this case be reduced from 5·57 feet per second for five hours, to 4·64 feet per second for six hours, in order to fill the space proposed to be left open—a velocity which will be found sufficiently high for every useful purpose connected with the navigation over the Bar of Lough.

A probable, almost certain, result of the exclusion of the tide from the Broad lough, will be to raise the level of high water at Cull Island and Duncormick above that which it heretofore obtained (from the indraught to the lough), and consequently some advantage in this respect will be derived, whilst at the same time a necessity will be created for raising the level of and strengthening the banks enclosing some of the low lands at Blackstone and Cull; in return for which, however, it is more than probable a lower level will be obtained for discharging their sluices, in consequence of the tides falling lower at this place than heretofore; and if necessary, their drainage waters can be discharged into the reservoir within the embankment.

The profile of the proposed embankment to seaward to have a slope of 2½ horizontal to one in perpendicular, protected by a strong rubble paving, and surmounted with a parapet of 3 feet in height over the top of the embankment, and 2 feet 6 inches at base.

Effectually to secure and protect this embankment from leakage, it is proposed, if upon further examination it shall be found necessary, to run two rows of sheeting piles across the channel and deep portions of the slob, and carry a puddle wall through the centre of the embankment for its entire length, to the height of the level of high-water spring tides.

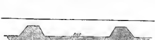
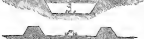
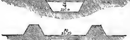
It would be desirable in the progress of the work, after the execution of the necessary sluices, sluice-tunnels, and channel, to lay down a rubble stone dyke, a few feet in height, in the line of the proposed embankment, which would cause an accumulation of alluvial deposit on the slob lands, thereby enriching their surface, particularly where they are of a sandy nature, and perhaps somewhat raising their level.

At the northern end of this embankment, at the land side, it is proposed to construct five sluice-tunnels, with self-acting gates of a width of 8 feet each, and also to construct two fixed or working sluice-gates to each of the proposed tunnels (as an additional security), dividing the space of one of the former into two of the latter, by a cast-iron upright frame, flanged or grooved, and so modelled as to receive one side of each of the working sluice-gates.

It is proposed that a reservoir be formed of the present channel through the slob and part of the Broad water, the rise of water in which, above level of low water of neap tides, not to exceed 23·86 inches, *i. e.*, the height at which the water can be retained in the reservoir without injury to the slob. The proposed reservoir to be capable, within the above limits, of containing 10,140,768 cubic feet of water, and will of course contain much more during spring tides; but throughout, I wish to make provision for the discharge under the most disadvantageous circumstances.

Before entering more fully into a detail of the plan proposed for the embankment and reclamation of the Ballyteigue mud lands, it may be desirable to show that so much of it as has been now stated is sufficient for the purposes intended; and in order to do so, I submit the following calculations:—

The following table shows the number of sections into which the proposed river is to be divided, with the declivity, area, velocity, and maximum quantity of drainage water, which is likely to fall on the catchment basin belonging to each section of the proposed river course in 24 hours, on the supposition stated in page 13 of this report.

No. of Section.		Length of each proposed Section.	Fall in proposed River per statute mile.	TRANSVERSE SECTION.	Mean Hydraulic Depth.	Velocity per Second.	Extent of Catchment Basin in statute acres.	Maximum Quantity of Drainage Water falling on the Catchment Basin in 24 Hours.	Capability of Discharge through each Section in 24 Hours.
		Stat. Per.	Feet		Feet.	Feet.		Cubic Feet.	Cubic Feet.
1	From Muchtown Mill to the junction of the Baldwinstown river	376	1·0		3.2286	2·3172	7,435	16,193,430	16,767,259
2	From Baldwinstown River to the junction of Muchtown River	444	1·0		3 9318	2·5808	13,314	28,997,892	29,580,673
3	From Muchtown to Duncormick River at Seafield . .	780	1·0		4·6000	2 8100	20,252	44,108,856	50,258,076

Total length 1,600 = five statute miles.

This calculation is made on the assumption of the fall being only 1 foot per mile; but during low water at the mouth of this new channel, or at any time in floods, the rate of fall per mile would be considerably more.

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Observations made on the Rise and Fall of Neap Tide outside the Bar of Ballyteigue Lough, on the 7th of May, 1843.

The relative heights are measured on a staff placed on the level of low-water neap tide of that day.

Time of observation.	Height of water on staff.	Time of observation.	Height of water on staff.
H. M.	Feet. Inches.	H. M.	Feet. Inches.
6 0	4·20=50·40	3 0	2·27=27·24
6 45	4·20=50·40	3 45	1·94=23·28
6 30	4·13=49·56	3 30	1·64=19·68
6 15	4·04=48·48	3 15	1·37=16·44
5 0	3·93=47·16	2 0	1·13=13·56
5 45	3·80=45·60	2 45	0·92=11·04
5 30	3·65=43·80	2 30	0·73= 8·70
5 15	3·48=41·76	2 15	0·56= 6·72
4 0	3·29=39·48	1 0	0·41= 4·92
4 45	3·08=36·96	1 45	0·28= 3·36
4 30	2·84=34·08	1 30	0·17= 2·04
4 15	2·57=30·84	1 15	0·08= 0·90
		0 0	0·00= 0·00

The descending neap tide found to be similar to that above given, but in a retrograde order.

The greatest fall of rain which has been recorded is, as stated in the foregoing part of this report, 1½ inches in depth in 24 hours, four-tenths of which it is assumed runs into the sea by the several rivers and streams.

This quantity of water running into the slob land from the 6,500 acres before adverted to, is capable of raising the surface water in the proposed reservoir to 1·35 inches per hour.

Now, supposing that the maximum fall of rain commenced at the time of low-water neap tides, the reservoir would at that time be empty; the sluices would then be closed by the ascending tide, and remain so for 10 hours, that is, until the ascending tide would rise to its maximum height, and fall again to the level of the surface of water in the reservoir, which, by that time would be 1·354 × 10 = 13·54 inches above low water.

At the expiration of this period the sluices would become active, and continue so for 4 hours and 30 minutes, when the surface of the water in the reservoir would, according to calculation, be 13·25 inches above the level of low water; then the sluices would again become inactive, and remain so for 7 hours and 30 minutes; at this time, being 22 hours from the commencement, the action of the sluices would re-commence, and the surface of the water in the reservoir would be found to be 23·86 inches above the level of low water.

It is unnecessary to follow the process further, because, as is shown above, the sluices are now in full power and their action will continue long after the expiration of the period of time which heavy falls of rain are observed to continue, for there would be at this time only two hours of it to expire, and moreover with a head of 23·86 inches, the sluices are capable of discharging a much larger quantity than can enter the reservoir during that time. Hence, it appears that the water in the reservoir would not at any time ascend higher than 23·86 inches, and would only remain at that height during the greatest fall of rain concurrent with neap tides, when, under such circumstances, it would still be 14·54 inches under the general level of the slob.

It appears, therefore, that the sluices are adequate in all circumstances to discharge the drainage water from the district or catchment basin, containing 6,500 acres, the waters of which cannot be carried off by the proposed new river course.

As these calculations are made with relation to the maximum ascent and descent of neap tides, it follows that during springs and all intervening tides the power of discharge will be greater, even under contingent circumstances, such as any of the sluices requiring or undergoing repairs. I may also observe, that if necessary, there exist means of extending the reservoir, or constructing additional sluices.*

It is proposed to construct a catchment drain round the eastern verge of the slob or lough to receive the drainage waters from the adjacent lands, and thence to the reservoir; or perhaps on further investigation it would be found practicable to convey these waters to the sluices on a more elevated level than the drainage water of the slob lands, and thereby obtain more time for discharge, and relieve the lower level of so much of the drainage waters.

It is proposed to adopt the present channel through the slob, which is sufficiently deep and broad to convey the waters from the proposed reservoir to within 125 perches of the site of the sluices; for this distance and 105 perches below the tunnels a new cut will be required, of sufficient capacity to allow the waters to run freely to and from the sluices. It will also be necessary to construct leading drains from the low lands now subject to floods, as well as minor drains through the slob itself, to carry off the water to the main drains, and thence to the reservoir and sluices.

I do not apprehend that there will be any leakage through the sand hills which form the southern boundary or seaward barrier to Ballyteigue Lough, in consequence of their great width and apparent solidity, particularly as no indication of such leakage has appeared in any of the low parts or hollows interspersed through the sand hills, although under the level of high water; and as the water inside the slob during spring tides does not fall within 6 feet of low-water spring tides outside, some opportunity was therefore given to test the sand bank, for if porous, there would be some trickling of water discovered along the shore, of which there was no appearance. Notwithstanding it would be desirable to construct a drain parallel to these sand hills, and at some distance from their base, which would receive any leakage, if such should hereafter appear, and by that means convey it to the sluices. This drain would be also useful as a boundary between the slob lands and the rabbit burrow, by which these animals would be prevented from entering the improved lands.

There are two mills on the line of the proposed new river course, namely, the Mulrankin and Muchtown mills. The latter will, by the proposed plan, not be interfered with, but rather improved, as it is intended to carry the tail-race water under the river course, and discharge it through the slob lands, and thence by the proposed sluices.

The former, or Mulrankin mill, it may be found necessary on further examination to purchase, as the level at which the Bridgetown water will be taken into the new cut may possibly interfere with it; but this mill is a very poor concern, and of very little value.†

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* No allowance is here made for evaporation from the reservoir, which, however, at some periods, would be considerable.

† The removal of this mill will afford the means of draining much land above it, which can be investigated upon the detailed survey.

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It is proposed to construct working sluices in the lower side of the proposed new river course, in two or three places, to give a command of water for the slob lands during dry weather, for irrigation, or other purposes, such as power for thrashing, winnowing, &c., as well as of sending down to the discharging sluices any quantity of water that may be required to scour out the channel leading from these sluice tunnels into the main channel, which runs seaward, as it is possible that some silting may take place below the proposed embankment after its construction, and perhaps in the channel leading from the sluices; if so it will be necessary to keep it scoured out.

It is also necessary to observe, that at the meeting of high spring tides and extraordinary land floods, the discharge of the water from the proposed new river may be retarded for some time; under such circumstances it may be found desirable to allow some of the surplus waters from the river to flow down into the reservoir in the lough, and these sluices will in such cases answer the purpose, whilst the sluicing power provided at the proposed embankment will, I feel tolerably confident, be sufficient during spring tides to discharge any moderate portion of these floods which it may be necessary to admit into the reservoir.

Having now stated generally the plan for the drainage of the flooded lands in this district, and the embankment and drainage of the mud lands of Ballyteigue Lough, which I feel justified in recommending as most calculated for the purposes required, I beg leave to submit the following estimate:—

Estimate.

	£.	s.	d.
Excavating five miles in length of proposed new river course, from Mulrankin mill, on the Bridgetown river, to the lower reach of the Duncormick river, including masonry of public and accommodation bridges, culverts, and three sluices in the bank of the new river to supply water to the slob lands if required	5,350	0	0
Constructing embankment to exclude the tidal waters from the slob lands, including puddle wall, piling, paving, and parapet wall, complete	4,000	0	0
Excavation, masonry, puddling, sheet piling in front of sluice-tunnels, and including 10 sets of working sluice-gates, and 5 self-acting with machinery, complete	1,568	8	0
Constructing at the Broad-water a reservoir to retain the waters which may accumulate within the slob during heavy falls of rain, whilst the sluices are inactive	350	0	0
Making 230 perches of a new cut to convey the water from the present channel in the slob to the site of the proposed sluice-tunnels, and thence to the channel below the embankment	450	0	0
4,000 perches of catchment drains round the slob, including main drains from the low lands adjoining, and watercourse from the proposed new river	800	0	0
Making 2,000 perches of minor drains through the slob lands	150	0	0
Repairing the present breaches of the rabbit burrow, and effectually securing and preventing the sea from washing over the low portions of the burrow	150	0	0
Contingencies, superintendence, &c., 10 per cent.	1,281	16	9
	£14,100	4	9
Purchase of land for the new river course, including damages, &c.	1,200	0	0
	£15,300	4	9
Expenses of preliminary proceedings under the Drainage Act, engineering expenses, valuations, &c.	350	0	0
Total, exclusive of interest on borrowed moneys during the execution of the works, which will probably take two years to complete	£15,650	4	9

The foregoing estimate is considered sufficient for the works necessary to drain effectually the low lands, now subject to be flooded, which will thereby at once become improved in their value, and also to effectually exclude the waters from and drain the slob lands; but as regards the subsequent cultivation of these lands, it must necessarily be left to the proprietors, and will not require more than two or three years to bring them into a profitable state. A much longer period of time would be necessary, were it not that the first preparatory step to cultivation can be very much assisted during the operation of the works, by thoroughly washing the slob with fresh water,* thereby freeing it of the saline properties, so far as such are found to be injurious to vegetation.

The soil of the slob of Ballyteigue may be classed under three different descriptions. The first consists of beds of mud, over-laying to a depth of several feet a sub-strata chiefly of sand and gravel, with traces of bog and clay; in the second the sub-strata is similar to the foregoing, over which rich alluvial deposits have been formed, of less depth than the preceding, but sufficiently deep for all agricultural purposes; the third consists chiefly of a formation of sand and alluvium mixed, and is consequently of a lighter and less valuable description than either of the foregoing, but still highly calculated, after a proper system of cultivation, to produce valuable crops, with the additional benefit of becoming more quickly available.

Of the 1,630 statute acres enclosed by the proposed embankment, there will possibly be 130 acres which cannot be calculated on as profitable, *i.e.*, a portion of the Broadwater above Ring's-nook, which is too low to be effectually drained during neap tides in wet weather, and will be required for a reservoir in addition to the present channel, which will convey the water to the sluices, together with some acres of unprofitable land at the verge of the slob, thus reducing the profitable land to 1,500 statute acres, about 180 acres of which is of inferior quality, being of a sandy surface, therefore reducing the superior description of slob land to 1,330 acres.

At a moderate scale of calculation, I estimate the improved rental value of these lands will be as follows, assuming that it would be brought into cultivation by tenants on lease, say for 21 years, or that the first few crops will pay the expense of cultivation:—

			£	s.	d.
1,500	1,330	acres of slob land, at 1*l.* 10*s.* per statute acre	1,995	0	0
	170	ditto of inferior sandy ground, at 1*l.*	170	0	0
	609	acres of land, liable to be flooded, the improved value of which after drainage would be at least 10*s.* per acre	304	10	0
	418	acres injured land would be improved, 3*s.* per acre	62	14	0
	318	acres would be improved, 2*s.*	31	16	0
		Annual value of the proposed improvements	£2,564	0	0

It will appear from the foregoing statement, that there will be 1,500 statute acres of slob land embanked in and reclaimed, the annual value of which will be 2,165*l.*, and 1,345 statute acres of flooded and injured

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* The neglect of this operation, frequently caused by the difficulty of obtaining a sufficiency of fresh water, very much retards the progress of profitable cultivation where salt-water marshes and slob-lands have been embanked.

APPENDIX B.

BALLYTEIGUE.

No. 49.

Russell, on the proposed Drainage of Ballyteigue Lough.

lands, the improved annual value of which will be 399*l.*, making together 2,845 statute acres, or 1,757 Irish acres, the improved value of which will be 2,564*l.*, for an outlay of 15,650*l.* 4*s.* 9*d.*, exclusive of interest, therefore yielding a return of upwards of 16¾ per cent. on the capital expanded.

In viewing the physical structure of the shore, and the facility which it presents to embank in the slob of Ballyteigue, the elevation and the rich nature of the soil, its fitness and capability to produce a succession of abundant crops without manure, and considering the great return and value of lands similarly situated and now embanked in from the sea in Great Britain, Holland, and various parts of the Continent, when compared with the outlay of capital, I have no hesitation in stating my opinion, that the slob lands of Ballyteigue will amply repay the capital invested in its embankment and reclamation.

But independently of considering this undertaking as a mere speculation of profit to the proprietors who may undertake it, there is another reason which strongly urges me to recommend the proposed measure, that is, that the labouring classes of this district will, by its means, get profitable and useful employment, not only during the execution of the proposed works, but afterwards in the cultivation of the improved lands, and thereby not only the amount of the estimate for the contemplated works will be diffused amongst them, but a considerable sum annually.

General Observations.

Considering these works in a national point of view, it is evident that the result of their execution will be to increase, *pro tanto*, the extent of the country, and consequently its resources, by the amount of increased produce which they would yield, whilst the exclusion of the tidal waters from the submerged lands injures no public right, and the drainage of the adjacent low grounds would be impracticable without it.

Amongst the advantages which are likely to be conferred by the proposed plan of carrying off the drainage waters of the upper district of country by a new river course, at a higher level than the Ballyteigue slob and adjacent low lands, may be mentioned the water power that will thereby be afforded for agricultural purposes, such as threshing and winnowing corn; this water power can be readily obtained by constructing water-wheels where such may be required, at the lower side of the new river course, from whence a supply of water can generally be had, except during low neap tides accompanied or concurrent with wet weather, because then the discharging power of the sluices at the proposed embankment would be at its minimum.

A power of irrigation will be afforded to the whole of the lands situate at a lower level than that of the proposed new river course, which, if employed with skill, must add considerably to their productiveness.

It is much to be regretted, that so valuable a fertilizer and promoter of vegetation as irrigation undoubtedly is, should be so little resorted to throughout Ireland; if we except certain districts in the county of Cork, and a few other parts of the country, where it is applied to a very limited extent. Much of this part of county Wexford has a retentive subsoil, and perhaps, until an improved system of under drainage is adopted, irrigation cannot be judiciously employed in it. It is remarkable, that although the inhabitants of this particular district of country are for the greater part superior in intelligence and industry to those of other districts, yet little progress has hitherto been made by them in under drainage, which is certainly the basis of all permanent and remunerative improvements in agriculture, and is the best preparative to be used prior to irrigation.

Whilst contemplating the resources of this district of country, there is none perhaps more remarkable than the facility with which its drainage waters could be made available, as a certain and cheap power for milling and other purposes. By constructing reservoirs on each or some of the rivers at convenient places and on a moderate scale, the water which now runs to waste could be detained, and thus a most valuable acquisition obtained in a country where windmills are at present in use, and resorted to, not, however, so much for the want of water, as the want of means to apply it usefully; for whilst there are 1,056,612,544 cubic feet of water running off annually from the 20,252 acres of the catchment basin, above the proposed new river course, without conferring the slightest advantage on the country (but, on the contrary, an injury from the rapidity with which it flows down on the low grounds), it could under proper management and controul be applied to every useful purpose for which so powerful a prime mover is adapted; and what seems rather anomalous is, that the very cause of the existence of its power is that which deprives the country of its advantages—namely, the great fall from the surrounding district, in consequence of which the water runs off so quickly, that the inhabitants do not consider it available for any useful purpose. Such reservoirs could with advantage be made to retain a portion of the flood waters, and prevent their too sudden fall into the proposed river course.

The project of embanking and reclaiming Ballyteigue Lough has, I believe, engaged the attention of several engineers; I have had the opportunity of examining and considering two plans for this purpose, and I may here mention, that in one of these it is proposed to construct an embankment across the narrow part of the channel, about one mile and a-half above the Bar of Lough, which is a bold measure, giving up, as it appears to do, all consideration of the navigation. The site selected for the purpose of constructing an embankment is a very good one; but if here erected, it would necessarily take in the Duncormick river, and thereby the drainage waters of 12,600 acres would, by the plan as proposed, have to be discharged by sluices through the proposed embankment, whilst the drainage water of the 26,752 acres, referred to in this report, would remain to be discharged through sluices at Crossfarnogue; these two quantities taken together will amount to 39,352 acres, an extent of catchment basin calculated to send down during very heavy falls of rain 85,708,656 cubic feet of water in 24 hours. It has been already observed, that the sluices could only be effective for 9 hours in the 24, and consequently inactive for 15 hours, during which time the quantity supplied by the catchment basin would, of itself, be sufficient to overspread the lands intended to be enclosed to a depth of upwards of 9 inches.

The other plan proposed was to construct an embankment at Cull Island, about three-quarters of a mile below the site selected by me for that purpose, and there to construct six sluice-tunnels, each 10 feet in width, on a framing of timber, supported by piles, and six self-acting sluice-gates; at Crossfarnogue also an equal number of sluices of similar dimensions was proposed. By this plan there would be 120 feet of water-way. Similar objections apply to this as to the foregoing plan, although the consequences could not be so injurious, because the Duncormick river would, by the embankment proposed by this plan, be excluded, yet the quantity of drainage water which would run down during the 15 hours that the sluices would be inactive, is sufficient to overspread 1,630 acres to a depth of 6 inches, as stated in a former part of this report.

It appears that the engineers from whom both of these reports emanated, concur in discharging the waters from the slob lands at Crossfarnogue; I am, therefore, the more desirous to bring this under the notice of the Commissioners, as by the plan now proposed for the drainage of Ballyteigue Lough, it is not intended to construct sluices at Crossfarnogue for the following reasons:—1st. As the same necessity does not exist for a second set of sluices, because by my plan the drainage water of three-fourths of the catchment basin is proposed to be carried off by a new cut or river course round the slob, and the discharge thereof effected outside of the proposed embankment. 2dly. As the expense of making a cut at Crossfarnogue, which must be effected by arching, tunnelling, or other equally expensive means, would probably amount to £10,000. 3dly. The difficulty of protecting sluice-gates of extraordinary dimensions, in a situation naturally exposed to the wash of a heavy sea; and, finally, though perhaps not the least important, that by the plan which I have proposed the whole drainage waters of the district will be discharged by their natural channel at Bar of Lough, and thus serve to maintain and keep open the navigation.

I have deemed it my duty thus far to enter somewhat into the detail of the respective plans proposed for the reclamation of the slob lands of Ballyteigue, and to call the attention of the Commissioners to them, who can thereby more readily judge of the feasibility of each. The proprietors themselves will also be better enabled to form some opinion in reference to the proposed plans.

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No. 49.

Russell, on the proposed Drainage of Ballyteigue Lough.

Having now fully stated my views on the practicability of the plan by which I propose to effect the drainage and reclamation of the slob lands of Ballyteigue Lough, as well as the drainage of the adjacent low grounds, I beg, in conclusion to observe, that in the investigation of the various and interesting facts connected with this subject, I have been led into what may be deemed abstract views and reasoning, which upon a cursory glance may not appear to bear directly on the subject under consideration; but it will be seen, that various circumstances of an unusual character necessarily involves the consideration of what may seem extraneous matter, which on a closer examination will not, I trust, be deemed irrelevant.

The varied and peculiar features which this subject assumes, requires not only mature consideration in an engineering point of view, but involves likewise results which the combined aid of science and engineering experience have been unable fully to foresee. I refer to the probable effects produced by works of a similar nature on navigation; some doubts may, therefore, arise on this part of the subject, as the slightest variation in situation or circumstance, which would be almost imperceptible, might possibly change in some degree the anticipated results. This, however, is the only part of the proposed measure on which it appears to me a doubt can arise; but, as I have already shown, all palpable circumstances seem to warrant the conclusion, that the mode here proposed by continuing the discharge of the whole of the inland waters over the Bar of Lough, and allowing an ample space below the site of the proposed embankment for the influx and efflux of the tidal waters, is the best calculated to improve, or, at least, not calculated to injure the navigation.

EDWARD RUSSELL, *C.E.*

No. 50.

Cubitt on Draining Ballyteigue Lough.

No. 50.

Report by W. CUBITT, Esq., C.E., F.R.S., *on the Draining of Ballyteigue Lough.*

SIR,

London, 10th May, 1845.

Adverting to your letter of the 22nd of March on the above subject, and with reference to the instructions therein contained, "That I should proceed to the place and examine into all the allegations on both sides the question, and report fully to their Lordships on its merits," I have now the honour to report, for the information of the Lords Commissioners of the Admiralty, as follows:—

I proceeded to Ireland in the latter part of the month of March, for the purpose of investigating this question, and devoted two entire days (the 31st of March and the 1st of April) to an examination of the lough, its entrance, surrounding shores, and rivers of supply, and examined various persons acquainted with the localities relative to circumstances of winds, tides, &c., connected with the inquiries.

I also took with me a well-qualified engineer (Mr. E. Purser), and left him on the spot, to take a complete set of levels and observations, during the week, of the spring tides at the new moon of the 6th of April, from which to make calculations and draw conclusions as to the probable effects upon the bar of the lough and the navigable channel, that would be induced by stopping out 1500 acres, or thereabouts, of tidal water at spring tides, by means of the proposed embankment, for the purpose of reclaiming and improving about that quantity of land, which is at present wholly or partially overflowed by the tides.

The case is briefly thus:—

Ballyteigue Lough is a tidal lake, containing about 2200 acres of surface at high water, lying close at the back of a range of sand-hills, extending westward from Crossfarnogue Point (exactly opposite the Salter Islands) for a distance of six miles, at which point is the "Bar of Lough," where the lake communicates with the sea by means of a channel or river course, about two miles in length, which forms a natural harbour, resorted to by shipping, and on which there are two trading establishments for the importation of coals and other articles, of which the average entries of registered tonnage, for the last five years, have been about 2000 tons per annum of coals, culm, slate, &c., imported for the supply of the immediate neighbourhood, burning lime, and other purposes. Just above the upper shipping-wharf (Watson's) a stream, called the Duncormac River, turns up into the country, and a little further up the channel the lough begins to widen and expand itself, at which point, about three miles from the bar, certain parties, acting under the powers of a recent Act of Parliament for the drainage of lands in Ireland, proposed to erect an embankment with sluices for stopping out the tide, and thus draining and reclaiming a very large tract of land, as above stated, and is fully described in the pamphlet, plan, and papers herewith returned. To this proposition the parties interested in the lough and its entrance as a harbour demur, and refuse consent to the measure, and hereupon issue is joined, which has led to this inquiry. The questions, therefore, are these:—

1st. Will the entrance to the harbour and the navigation to the shipping quays below the mouth of the Duncormac River be injured by the proposed drainage and reclamation of lands? and 2nd. To what extent?

In all matters of this kind much must depend upon the judgment where absolute proof is impossible; and the production of a vast mass of figures, lines, and levels would but little assist the case, or add to the information of the reader, and very probably tend to confuse it. I shall therefore proceed at once to answer the first question, by stating that, from all I have seen or heard on the spot, the observations and examinations taken by my assistant, in a very careful set of experiments, and all I have read on both sides the question, my deliberate and decided opinion is, that the navigation channel and entrance, and the Bar of Lough, *will* be injured and deteriorated by the proposed measure of drainage.

As to the second question—

The extent of the deterioration that would accrue from stopping of the "Lough" and "Broadwater" from the tide, that is not so easy to answer, inasmuch as, from the same obtainable data, ten different engineers might draw as many separate conclusions in point of degree, though all might admit some.

The facts bearing on the case are—

That average spring tides rise about	11 ft.
That ditto neap ditto	6 ft.
That at low-water springs the depth of water on bar is from .	2 ft. to 4 ft.
Ditto at neaps	2 ft. to 4 ft.

That during neap tides the bar accumulates, the force of the current at that time not being strong enough to remove such accumulations, which invariably remain till the succeeding spring tides.

That the spring tides are but just sufficient to keep the bar in its present state.

The tidal stream of spring tides inward during the strength of the flood is about four miles per hour in the sea reach of harbour channel, and the ebb tide rather more than six miles per hour for upwards of two hours during the strength of the ebb, at the same place, namely, between Yellow Hole and the bar.

At neaps the run of the tides may be taken at, or rather more than half the above velocities at flood and ebb at corresponding times. The flood stream continues to *flow* five hours, and the ebb stream to *run* seven hours in the sea reach: but at the site of the proposed embankment, nearly four miles up by the course of the channel, the flood runs up 4¾ hours, and the ebb runs out 7¼ hours. If the whole quantity of water at present flowing into the lough and applicable to scouring the channel and keeping down the bar, be represented by 1000, then the quantity flowing in at a similar tide after the embankment be made will be about 600, and the total quantity now flowing in during a *neap* tide, applicable to scouring the channel and bar (but which it does not effect) being 400, and after the embankment be made, but 300, it shows that the total scouring power of a spring tide, after the works would be completed, would be, to the power of a spring tide at present, as 600 to 1000, and of a neap tide as 300 to 1000, but to that of a neap tide at present as 600 to

Appendix B.

Ballyteigue.

No. 50.

Cubitt, on draining Ballyteigne Lough.

400. I therefore infer, from the above premises, that the scouring power of spring tides, after the works are completed, will, in effect, be little, if any, more or greater than that of neap tides at present, and that in consequence the channel will become shallow or silt up, and the bar will rise and increase, as it does now in neap tides, from not having the advantage of spring tides such as at present to remove the accumulations; more particularly as the neap tides subsequent to the embanking off the lough will be less than at present by one-fourth of the whole quantity, or as 300 to 400. Another result, arising from this state of things, would be a growing up of the bar and outfall channel which would back up the water upon the sluice-doors, and prevent the back water from draining off to the level of the present low water, as there would, in my judgment, very soon become a fall at low water over the bar into the sea, from a want of a sufficient power of back water to clear away the accumulation of beach at the bar of lough after great storms, which would then have a great tendency to stop up the entrance.

On the whole, therefore, I conclude that if the promoters of the drainage improvement carry out their measures, a considerable quantity of land will be reclaimed and improved, but, from causes above alluded to, not to the extent that they anticipate, except they could drain more directly into the low water of the sea; and also that the navigation would be so far deteriorated in a short time, as to prevent vessels, of the tonnage and draught of water now used, from availing themselves of the harbour as they do at present.

I am, &c.,
Wm. Cubitt.

New Ross.

No. 51.

Galavan, on the State of the Harbour.

No. 51.

NEW ROSS.

Mr. J. Galavan *on the State of the Harbour.*

New Ross, Co. Wexford, 5 *Feb.*, 1845.

Sir,

In obedience to the desire of the Secretary of State, Sir James Graham, and in pursuance of a Resolution of the House of Commons, dated 9th August, 1844, I have the honour to inform you that the Town Commissioners of New Ross, appointed under the Act of the 9th of George IV., chapter 82, are in receipt of the quay and river tolls payable to the late Corporation of New Ross, and apply the same in repairing the quays, supplying sufficient moorings for vessels, and defraying the salary of a water-bailiff, whose duty is to collect the toll, and enforce their regulations.

The toll is payable by prescription, and not under any local Act of Parliament. The late corporation was incorporated under various charters, viz., the 1st of Henry VIII.; reciting the old charters of Edward I., Richard II., Edward IV., Henry V., Henry VI., and 9th James I., 3rd Feb., 1611, and 3rd James II., 13th Jan.

The toll is quite inadequate to enable the Commissioners to remove obstructions to the navigation of the river, and they have received many verbal complaints from ship-owners, masters of vessels, and pilots, of vessels sunk in the channel of the river, where they still remain, to the great injury of the navigation and danger of vessels coming to this port, from want of the necessary funds to remove the same. There are also sand-banks and other obstructions which could be removed at a small expense, save for the reason before mentioned. I have no copy of a map of this port, nor any report made by engineers or other officers respecting it.

In the present defective state of the navigation, vessels of 800 tons burthen arrive at our quays; but with some expenditure in removing impediments, vessels of 1,000 and 1,200 tons burthen could do so.

The registered tonnage of vessels belonging to this port amounted, in the year 1842, to 2,170 tons, in 1843 to 2,176 tons, and in 1844 to 4,328 tons; and the import duties for 1842 amounted to 24,396*l*., in 1843 to 20,198*l*., and in 1844 to 22,703*l*.; and in addition to the above there was import duty paid by a Ross merchant for goods warehoused in Waterford, in the year 1844, amounting to the sum of 6,190*l*.

The number of vessels in the Coast Trade, entered at the Custom-house this year, were,—Inward, 465—Outward (loaded), 123—Foreign, 24.

I also beg leave to observe that the navigable rivers Nore and Barrow unite about a mile above this town, and are connected with the Grand Canal, which passes through several counties; consequently, this is the best port for shipping their produce.

I have, &c.,
James Galavan,
Chairman to the Town Commissioners of New Ross,
Co. Wexford, under 9 *Geo.* 4, *cap.* 82.

To the Under-Secretary of State.

Waterford.

No. 52.

Evidence taken on the 8th Sept., 1845.

WATERFORD.

No. 52.

Examining Commissioner—Captain Washington, R.N., F.R.S., assisted by Captain Frazer, R.N., Admiralty Surveyor on the Coast of Ireland.

Present:—Mr. R. F. Sweetman; Alderman Meagher; Mr. Power; Mr. Ardagh; Mr. J. Kent; Mr. Davies, of Clonmell; Captain Kellet, R.N., Inspecting Commander of the Coast Guard; Lieutenant Smith, R.N., of H.M.S. *Lucifer*; Mr. Rose, H.M.S. *Jasper*; Alderman Forristal, &c.

[*The Admiralty Chart of Waterford, by Captain Frazer, R.N., and Assistant, on the scale of six inches to a nautical mile, was laid on the table.*]

Mr. Benjamin Conn examined.—I reside in Passage, in the county of Waterford, and I have been pilot-master to the port, harbour, and river of Waterford, since the first formation of the harbour-board in 1816. There has been deterioration since Doilley's survey. It would be very difficult to procure that, but Mr. M'Kenzie's survey I can produce for you. At the time of Doilley's survey it was deeper at the entrance below the bar than it is now. Since that survey it has shallowed considerably, but not on the bar; the shallowing has occurred considerably below the bar. Since I have become pilot-master, the depth of water has decreased in many places over shoals and banks of mud; in the fair way of the river the mud has been allowed to accumulate in three banks. The depth of water at present at the quays at Waterford is quite different: at the lower part of the quay it is so much as ten fathoms; opposite to this place it is not more than two and a half fathoms at low water. There is a flat, or mud bank, extending out in this part of the harbour.

APPENDIX B.

WATERFORD.

No. 52.

Evidence taken on the 8th Sept., 1845.

COMMISSIONER.—Are you aware that about the middle of the quay (opposite Paul-square) there is a flat or mud bank stretching across the river; Captain Frazer, who surveyed the place, found it there?

WITNESS.—I am aware that a great accumulation of mud had taken place there, and it might have extended across. The steps taken to remove this accumulation consist in a dredge-vessel, at present employed in removing the mud from the quays. No steps have been taken for removing this particular bank, but by the mud bank being taken away from the quays, it follows that a part of this will be removed also. I am not aware why it should not be directly applied to the removal of that bank, if it is necessary that it should be done; it has never been so applied, nor have any steps been taken to direct the current so that it would take away the mud from the quays, but I understand the matter is under consideration. I cannot say whether the dredge-boat has been employed especially to remove the bank spoken of, as this part of the harbour is not under my control.

COMMISSIONER.—I see a sum of 925*l.*, stated here for salaries to secretary and treasurer, under-secretary, and harbour-master; on which of those devolves the duty of seeing the operations of the dredge-vessel carried on?

WITNESS.—I have nothing to do with it; my duty is to superintend the pilots. There are 30 pilots. They pass an examination before a committee of the harbour commissioners and the pilot-master. They are paid by salary. Their outer station is in a line from the Saltees to Great Newton Head; their middle station from Bag and Bun to Tramore; and their inside station is from the Hook Light to Dunmore. The 30 pilots are found sufficient for the accommodation of vessels coming to the harbour. I have heard no complaints.

COMMISSIONER.—Do you think the system of allowing pilots wages equally good as if they were allowed to earn what they could?

WITNESS.—That is a question I am delicate in answering. It would have been well if they were paid in this manner since the commencement; but some of the present pilots have been 30 years employed under the present system, and if there was a change now, many of them would suffer severely by it, not being able to contend with the younger hands. This is my opinion; I think it would be a hardship, and a great one to them, if the system of earning was now introduced instead of salary. It is only when they are rendered unserviceable by age, sickness, or accident, that they are superannuated. A man's age might be 70, if he were sufficiently strong and his mind able for it.

COMMISSIONER.—I see a sum of 923*l.* charged as the expenses of pilots for the year; is that sum necessary?

WITNESS.—I conceive it is not too much. The first class pilots are paid very little under 50*l.* a-year. There would be a difficulty in superannuating the present pilots, and throwing it open to another body of men sufficiently qualified and able to discharge the duties; if there were funds it could be done; but there are only 200*l.* a-year allowed by Act of Parliament for the superannuated pilots, and that is already disposed of. There are sufficient lights and buoys on the harbour, but I would make some additions to them. I would buoy Broom-hill with three buoys, and on Seed's-bank I would place two buoys. There is a part of it dry at low water; the pilots know it. If the weather was very thick you could not see the marks; but we never go up the river unless we can see either side, and when we can that is a safe guide. I do not recollect any other buoys wanted; there are plenty of buoys in the King's Channel. There was a vessel sunk there, and whilst she remained there she was a good mark; but she was removed in some degree by persons who came here a few years ago looking after wrecks, and they put a barrel of gunpowder into her and blew her up, and there is a buoy on it now a sufficient mark—it is very small, but it is sufficient. On the bar there are somewhat larger buoys. The government packets are in the habit of running up here at all times. Had never known them to be detained going up or down. There is about 14 feet depth of water on the bar at ordinary springs; it is something deeper than it was; when this chart was drawn, it was no more than 13 feet.

COMMISSIONER.—Was not the harbour at Dunmore built on the supposition that the government boats would not have water over the bar?

WITNESS.—I rather think not; I had a conversation with Captain Coote, when he came here for the purpose, and from that I am led to believe that such was not the purpose for which the pier was built. Some of the mud raised by the dredge is drawn away for manure, and other portions of it are dropped in deeper parts of the river. It is probable that the running tide will draw that away again. The embankment making down the river, between this and Passage, is taken in by the Board of works under an act of parliament. The permission of the harbour commissioners was not asked. Each proprietor, if he pleased to embank, would not be resisted by the commissioners—they never interfere. I would recommend the cut on the Ford to be extended in length and breadth; I would also recommend that the entrance to the King's Channel should be deepened by dredging to the depth of about four feet below the present surface. Not above 100 yards of the bar would require to be deepened; if that were done, vessels could enter the channel before the tide began to make strong, and that is a great object, as eddies are then formed, and vessels are likely to be caught in them. The Burchall bank has been injurious. The eastern end has increased considerably within the last few years; thought it was caused by the droppings from the dredge-boat. But the increase began before the dredger commenced working. There is another shoal off Cheekpoint that should be dredged: it is not a hard bottom, and there is nothing to prevent it from being dredged; and I would bring it to the same breadth and depth as the King's Channel, and I would dredge the bar at a particular part. These are the improvements I would recommend. The nature of the bar is of a shingly description, intermingled with mud and stones; there would be no difficulty in removing it; I think it would maintain the depth after. In this particular part, where the scour of the tide is, it retains the same depth, and if you lowered the parts it would keep the same depth; the run of the tide would keep it clear. I am confident it would increase the trade of the harbour if there was no bar; and even the expense of its removal would be paid if there was an increased depth.

COMMISSIONER.—Are there any obstructions to navigation in the river Barrow?

WITNESS.—There are several obstructions in the Barrow. The most dangerous part is Lucy's rock; there is a large and extensive flat, called the Red bank, below that. Above Ballinglaw the river should be deepened. Otherwise I would not recommend deepening in any particular part, as it

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would be quite useless, for the river is flat all through. Vessels of 800 tons' burden can go up to Ross Quay at present at high water.

COMMISSIONER.—Have the harbour commissioners of Waterford jurisdiction over the Barrow?

WITNESS.—That is disputed; they have taken no command upon themselves; the Barrow is under a distinct system of pilotage; we never supply a pilot unless the master of a vessel require it. The Ross pilots are not examined before any person. Wrecks occurred very frequently in this harbour before the branch pilotage was established, caused by want of pilots and buoys, and also the want of proper regulations in supplying pilots. The navigation has improved within these 30 years exceedingly, so as to prevent wrecks, and that speaks volumes. The water has been deepened at the quays here by the dredging-boat.

COMMISSIONER.—The Act under which the harbour commissioners were incorporated gives them jurisdiction over the river from Hook Tower to Bilberry Rock, and therefore it is clear that the estuary at Buttermilk Castle, is comprised in the port of Waterford, and no person, I conceive, has right to interfere between those two points with the river, without their permission, I also think that the bridge proprietors have no right to stop the passage on the Queen's highway; nor do I think they have a right to charge for raising the portcullis.

WITNESS.—Vessels with masts trade above the bridge and pay a toll. There is no Act authorising a toll on vessels. The lights in the harbour are sufficient. The light at Duncannon is a leading light; it will take you in past the bar; there is no light required further up. The lights are supported by the ballast board in Dublin. Has never known the mail packets to be detained for want of lights.

Mr. ARNAGH.—You say the shoals are increasing; do they interfere with the navigation?

WITNESS.—None of them are sufficiently increased for that. There is a patch on the bar where there is but nine feet of water, and Nimmo must have met with that spot, when he represented our bar as only having nine feet of water. That was referred to me at the time they were about building Dunmore pier, and I contended there were 14 feet of water, and an officer was sent down, who examined it with me. When Captain Sir Edward Parry went with me he fully proved this; and when Nimmo and Sir T. Coote called on me, and had a conversation, I pointed out the site of the present pier, and Sir T. Coote told me confidently that when he would go home, be would recommend the Admiralty to have nothing to do with it, as it would cost 200,000*l.*; if they had extended the pier to the Black Rock it would have cost that, but it would have made a very fine harbour. Was well acquainted with the coast round to Wicklow Head; knew the Blackwater Bank; considered it very dangerous; thought a buoy would be of great service on it. Have made made inquiry as to what sort of oil was used in the lights along the coast; heard of the French lights; did not know it was with rape oil they were lighted; knew the Waterford lights burned sperm oil.

FRANCIS KELLY examined.—Have been master of the dredge-boat about four years, but have not been working two; she was found at first to be inefficient. The boat raises in a day about 300 tons. The engine is of 24-horse power, and began working on the 30th March, 1844. The ladder is so short that we cannot dredge at high water. The expense of dredging is *6d.* per ton. Would not be capable of dredging up the King's Channel. We could not work her well, the water is too deep.

COMMISSIONER.—Then am I to understand you that a dredge vessel, built at Waterford, specially for dredging Waterford harbour, has her ladder too short?

WITNESS.—Yes. The soil is composed of different sorts: some of it is dry marl, and there is also gravel and shingle. Some of the stones are as large as three cwt. and do not break the buckets, but they knocked the lip from off one of them. Only one of the buckets is lipped. The mud-lighters are moved down the river when full, and their cargoes deposited in the King's Channel.

Captain PRICE, the former harbour-master, examined.—Did not think the dredge-boat would be sufficient to clear the bar; she was built at the Neptune Foundry at Waterford, by the Messrs. Malcolmson, by specification, with a ladder 18 feet long, which was afterwards shortened by an order of the harbour commissioners. Often dredged on the Ford; took up stones there of 10 cwt. Often saw freshes in the river; could not tell what course they took. Has frequently seen freshes in the river; the current there sets from the opposite side against the quay at the growing bank; thought a set could be given to the tide that would turn the run of the water against the quays, and so clear away the mud; but it might cause eddies on the other side and create mud locks there. Knew the sand bank opposite Mr. Ardagh's store; thought it would be a great saving to have iron stages instead of wooden ones; did not know of any worms in the water here to destroy timber—at Dunmore plenty.

Mr. CONN stated the number of arrivals at Waterford, in the years 1816, 1817, was 700, and it has now increased to 2,460, and an equal number of sailings

Alderman MEAGHER then handed in the following documents, as to the amount of tonnage belonging to the port, from the water bailiff:—

Year ending 31st March, 1844, 1,398 vessels; 163,451 tons.
,, ,, 1845, 1,432 ,, ; 162,627 ,,

The services of the harbour commissioners are gratuitous: they are 12 in number; there is no qualification; five of them are selected by the Chamber of Commerce of Clonmel, and seven are elected by the town council of the city of Waterford.

The Granagh Bridge, if erected across the river by the Waterford and Limerick Railway Company, will have an arch sufficiently high to allow all vessels to pass under it.

Captain BELLORN, water-bailiff, examined.—It was his duty to attend to berthing vessels in the harbour; if ballast were thrown into the stream, the parties would be liable to a penalty.

Captain NEWPORT was of opinion that the harbour of Dunmore was filling up; had lived in Dunmore for many years; very little trouble would clear it out; no dredge for 20 years; could not tell what effect gales of wind had had on the pier; thought it was a great error in Mr. Nimmo not to erect the pier much farther out; he would even suggest that every stone of the present pier should be taken down, and a new pier erected; it would then be available as a harbour of refuge; he thought there was no part of Ireland more capable of being made a harbour of refuge than Dunmore; it was also most valuable as a fishing harbour.

Mr. POWER.—There is a fishing pier very much wanted at Tramore; a fishing harbour there, in the Ladies' Cove, would be of the greatest advantage to hundreds of poor fishermen, who often risked the loss of their boats for want of such trifling shelter as might be afforded at very little expense.

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William Thompson examined.—At present I am ballast-master; I have been several years superintending the quays. I do not consider that the pigs that are shipped on the quays interfere with the traffic on the quay. Several persons stated this was considered a nuisance, but that it was now provided for by a bye-law of the corporation. Was not acquainted with Glasgow and Liverpool quays, and did not know that certain portions of them are set apart for embarking live stock.

Mr. **Cheray** examined.—Had witnessed very little change in the harbour, but there are many improvements. It is pretty well buoyed, and I do not know any place that buoys are wanted, except at Seed's-bank. Had in his possession, two years ago, a chart of a survey made in 1640. At the time the present chart of the harbour was making by Carter, took some interest in it, and compared the soundings of one with the other, and found they were pretty nearly correct. Suggested that a light should be put at the eastern end of the island, and also that the stones at the end of it should be removed.

Mr. **Rose**, master of H.M.S. "Jasper," examined.—Had been running to Waterford for about seven years; had often come up the river by night, and did not recollect that he was detained at any time; there were nine feet of water on the bar; was never detained by the bar; there was not as heavy sea over the bar as at the other side. The Duncannon light is a great improvement; it is quite sufficient; did not think there was a light wanting at the eastern end of the Little Island, as he thought it would be calculated to mislead. The only suggestion he had to make was, that a buoy should be placed over Seed's-bank. Considers the King's Channel sufficiently buoyed. Did not think there was any difficulty in making the harbour; never found it; considered the harbour to be a very fine open one, but it was necessary to use that precaution in entering it that should be exercised in entering a harbour. Has been prevented from getting out of the harbour. The vessel is of 100-horse power. If prevented from getting out of the harbour, would not think of running into Dunmore, unless an accident happened to the engines; would run up to Duncannon, or Passage, or under Buttermilk-point. It is difficult to get out during south-east gales in winter; some winters they are very prevalent and others they are not; do not find that it has occurred oftener here than at Milford, which is considered the best harbour in the world; was sailing into Dunmore for some time; the steamers had to be swung there by hawsers. Frequently found the navigation of the river obstructed by stones thrown out of the lighters.

Mr. W. **Davies**, of Clonmel, Chairman of the Suir Navigation Company, offered some suggestions as to the state of the navigation from Waterford up to Carrick. There is, he said, on an average, when the tide is out, from three to four feet depth of water at Carrick quays. The tide rises five feet at neap, and nine at spring tides, and flows three miles above the town; the river in its present state is navigable by vessels of 180 tons, but improvement is much wanted: there are obstructions in parts of it, but none that a steam-dredger might not easily remove, if the portcullis of Waterford Bridge had been wide enough to admit a steam dredging-vessel to go through, but it is not.

Alderman **Forristal**.—The portcullis is 24 feet wide, and the centre arch of the bridge 60 feet wide. The river steamers can go up to Carrick, and a Government steamer once went up there.

Captain **Price** thought it would be most important that the Hook Lighthouse, at the entrance of Waterford, should be painted black and white instead of all white. He often in foggy weather saw the roofs of the cottages in coming in from the westward, and could not see the lighthouse.

Captain **Hearne** fully agreed with Captain Price that it would be better to have the Hook Lighthouse painted black, or red and white, instead of all white. It was impossible to see it in heavy weather. In the river, also, are black buoys on the starboard, and red buoys on the larboard hand, while in every other part it is exactly the reverse. The buoys made no difference to him, but it might be of great importance to a stranger. He often passed the Tuskar light; thought it would be better if the revolutions of that light were quicker than two minutes; if there were a light on the Coningbeg rock it might often save the inconvenience of making the Tuskar; often came inside the Saltees; there is a dangerous rock inside the small island called the Goose rock; was of opinion that it would be a great improvement if the stones were taken away from the Kilkenny side of the Waterford river.

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Cubitt's Report on the Harbour.

No. 53.

Mr. **Cubitt's** *Report on the best means of improving the Harbour.*

31st July, 1838.

Having visited the harbour of Waterford in the early part of last June for the purpose of examining its state and condition, with a view to the best means for its improvement, and to enable me to answer certain questions relative thereto, I have now the honour to submit my Report thereon.

The following are the questions put for my consideration, viz.:—

Question First.—"What have been the chief and combining causes of the rapidly increased and increasing accumulation of mud in front of the quay and in the river generally?"

Question Second.—"Could the various currents visible in that portion of the river opposite the city be, by artificial means, so concentrated, as to act during ebb tides with sufficiently increased force to prevent deposits near the verge of the quay?"

Question Third.—"Would the proposed extension of the quay be likely to contribute in any, and what degree, towards the attainment of that very desirable object?"

Question Fourth.—"Supposing such extension to be productive of advantage for only a definite period, would not the expenditure be justifiable, especially as a steam-dredge could, at any and at all times, prove a valuable auxiliary in removing deposits of every description?"

Question Fifth.—"The Commissioners having recently purchased the hull of a large ship (the "Olbers,") with the view of converting it into two or more floating stages, and having obtained a proposal of contract to cut her fore and aft into two hulks for that purpose, finding all materials complete, for a sum at or about 700*l.*, they are desirous to know whether you consider that, under the circumstances, this plan would be advisable to carry into effect, or if you could suggest any more advantageous way of making it (the hulk) available?"

Question Sixth.—"The Commissioners have recently expended a considerable sum in excavating, quaying, and otherwise improving the pier harbour at Duncannon Fort, and have some further improvements there in contemplation, plans of which Mr. Cubitt has seen; they desire to know Mr.

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Cubitt's opinion as to the most effectual and economical manner of completing that work, so as to afford the greatest security to steam-boats within the pier, and accommodation to the smaller craft at the pier-head (at low water) to discharge or load?"

Question Seventh.—"Mr. Cubitt has visited the old docks at Passage and Ballyhack, and observed the manner in which they are filled with shingle and sand; he will please to state his opinion as to the utility of clearing them out, and any suggestions he may offer for their permanent improvement, so as to afford shelter for small craft?"

Question Eighth.—"From the opportunity Mr. Cubitt has been afforded of observing the different localities of this river and harbour, the entrance of the King's Channel, and the passage of the cut through the ford, the Commissioners request he will favour them with any suggestions for the improvement of those parts which his professional knowledge and experience may enable him to offer?"

Question Ninth.—"The Commissioners are anxious to learn if, in the event of their at any time proceeding to deepen and widen the Ford, that any injury could arise by depositing the material taken therefrom in any part of the King's Channel, and what part would be the safest place for such deposit?"

The above being the subjects referred to my consideration, I shall proceed to answer them as briefly as I can *seriatim*, and afterwards make such general observations upon the whole as may appear to me to be necessary.

Answer to Question First.—The chief and *combining* causes of the rapidly increased and increasing accumulation of mud in front of the quays are, the natural formation of the river just above and below the line of quays, and the increased and increasing trade of the port.

The first cause gives a tendency or "set" of both the flood and ebb streams respectively towards the north side of the river, leaving the principal part of the line of quays in comparatively still water, thereby inducing a deposit of mud; and the second cause tends still further to increase that deposit, from the necessity that exists of increasing the number of loading stages or floating jetties, which, by driving the vessels and craft further out from the quays, causes still water in a greater degree within the line of vessels and close to the quays.

Answer to Question Second.—I have no doubt that the current of the river can be directed along the front of the quays by artificial means, so as to act during ebb tides with a sufficiently increased force to prevent such deposits near the quays, as would hinder vessels from lying afloat at all times outside the floating stages or loading jetties.

The means by which I would effect this object permanently is the erection of a jetty or turnwater on the north side the river below the bridge, commencing just below the patent slip, and extending about 750 feet in length to a point 500 feet distant from the quays, in a line with Barronstrand Street (See sketch at the end of this report.)

The effect of an erection of this kind would be to give the whole of the water of the river, after passing through the bridge during the ebb tide, a "set" or direction parallel to and along the face of the quays, so as to preserve a sufficiently deep channel at such a distance therefrom as would enable vessels to lie afloat at all times outside the floating stages, and to prevent the latter from grounding, without coming so near the quay wall as to endanger its stability; whilst under the same circumstances, the tide of flood would still continue to act with sufficient force on the north side of the river as to prevent any accumulation of mud on that side, except *immediately behind the turnwater;* part of which, at the upper end, might probably be reclaimed in course of time for the extension of the ship-yards and ballast quays.

The cost of a work of this kind would probably be from 12,000*l.* to 15,000*l.*, and would, in my opinion, be a permanent remedy against the accumulation of mud on the city or quay side of the harbour, without injuriously affecting the shores of the north side below the ballast wharfs, or the end of the turnwater for the reasons above stated.

Answer to Question Third.—The extension of the quays further into the river would contribute in some degree towards obtaining deeper water alongside the quays, but in a far less proportion than would be commensurate to its cost, inasmuch as carrying out the quays would tend to divert the water still more to the opposite side of the river, and from being necessarily more curved outwards, would retain the tendency to form a shallow shore by the deposit of mud, aided, as at present, by the floats and vessels alongside; besides which, the new quays, from having to be founded much deeper, and built larger and stronger, than the present quays, would probably incur a cost of at least 20,000*l.*, a sum much larger, in my opinion, than the circumstances would warrant, when it is considered that the present floating stages and bridges, for the purpose of loading and discharging vessels, would continue to be retained; and which, from their very great utility and convenience (setting aside the necessity for them), would most probably continue to be used for all the steam business at least, although the depth of water alongside the quays of Waterford might be deep enough to float any vessel at low water.

Answer to Question Fourth—This question is in some degree replied to in the preceding answer. I do not think the expense of new quays would be justifiable, if dredging is proposed to be resorted to as an auxiliary; because I am of opinion, that dredging alone, properly applied and conducted, would effect the object of itself, leaving the quays as they are.

The cost of a good dredging-engine, and a sufficient number of proper barges, would involve an outlay of about 5,000*l.*

The above apparatus, well and effectually worked for one year, would clear out a channel along the outside of the present floating stages, having ten feet at low water (or more, if necessary), sufficient for vessels to lie afloat at all times, at a cost of about 5,000*l.*, and maintain the same at an annual expense of 500*l.* or thereabouts; so that, with an outlay of 1,000*l.*, in the next two years, the quays might be entirely freed from mud at a proper distance therefrom, and kept clear for 500*l.* per annum after that time, and most probably for less; besides which, the Commissioners would be in possession of a most useful and valuable apparatus, which would be available at all times for dredging and removing obstructions in other parts of the river and harbour besides the quays.

Answer to Question Fifth.—As regards the hulk "Olbers," my opinion is that, if cut in two horizontally, and each half made complete, at a cost of 700*l.*, the Commissioners would be in possession of two very good floats; but, at the same time, of a size and form that would be rather unwieldly, and such as would require proportionate expense in fitting out and attaching to the quays; besides which, from the very circumstance of their size, &c., it would be more necessary to have them lie, if possible, in a situation with sufficient depth at low water to prevent their grounding at every tide.

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The only suggestion that I can offer on this subject is, whether it would not be advisable, before proceeding to cut the vessel in two, to have her surveyed, and to ascertain if a more convenient float or floats could not be constructed out of the same materials, and at a reasonable expense, than by cutting the vessel in two.

My opinion with regard to these floats is, that they should be *very long*, narrow, with a small draught of water, and as light as is compatible with strength.

Now, I have little doubt but there are materials enough in the "Olber's" hulk, if carefully broken up and assorted, to build two floats, each 200 feet long, and 15 or 16 feet wide, which, with straight sides and flat bottoms, would draw very little water, and when laid end to end, with two bridges each from the quay, would form a continuous wharf 400 feet long, capable of accommodating two large steamers and three other vessels each at least, and in a more convenient manner than the hulk in its present form cut in two; or probably the proceeds of the hulk might build *three* smaller floats, if that were thought more convenient. At all events, I venture to submit that the investigation is worth making.

Answer to Question Sixth.—The works executed at the pier harbour of Duncannon Fort appear to me very judicious, and only require to be carried out by the completion of the pier-head with stairs, &c., agreeably to the modification of the model for that purpose as seen and approved by me on the spot, and the removal of the rocks at the entrance nearly opposite the end of the pier, to facilitate the entrance of vessels under peculiar circumstances of winds and tides.

I would also recommend the erection of a rough stone breakwater across the rocks from the shore towards the pier-head, which would prevent heavy seas at the time of high water from ranging along the shore, and render the harbour more quiet inside. If this were done, with its outer end or head of cut stone, and surmounted by a strong warping-ring, the harbour would be rendered as complete as need be, and sufficient for all its intended purposes of steamers and small craft for the accommodation of the adjoining country.

Answer to Question Seventh.—I deem it useless to attempt clearing out the old docks at Passage, inasmuch as without the erection of expensive protecting piers to stop and turn off the shingle and sand into deep water, the same causes which have filled them up would doubtless fill them up again.

The pier at Ballyhack appears to me very convenient, and well adapted for the use of steam-vessels to land and take on board passengers, &c., but there should be more fenders, mooring-rings, &c., for the vessels to bring up to, and to a greater extent along the pier, so as to admit a greater range of length for vessels running alongside the pier at different states of the tide.

Answer to Questions Eighth and Ninth.—Next to the quays of Waterford, I deem the improvement of the Ford of the greatest importance to the trade and navigation of the port, and strongly advise the Commissioners not to lose sight of that object, as an addition of three feet only to the depth of the Ford Channel would render it available at all times of tide for almost every class of vessels which frequent the harbour of Waterford, and render almost (if not quite) unnecessary the navigation by the rocky and circuitous course of the King's Channel.

Whenever the Ford Channel may be dredged, no harm can arise to the King's Channel by depositing the materials dredged from the Ford in the deepest parts of the King's Channel, taking care to begin with the very deepest part first, and not depositing any stuff at less depth than 3½ fathoms to its surface at the lowest low water.

In dredging the Ford it may be observed, that the same description and power of dredging-engine and machinery, as is best suited for the work along the quays and other parts of the river, where the bottom is composed of clay, earth, sand, or mud, is not at all suited for the dredging of the Ford, where the bottom is hard and rocky; and as the engine, &c., for the quays would be required for a constancy, and those at the Ford only for a temporary work, I should recommend that the apparatus for the latter be hired of a kind proper for the purpose, and the former purchased of the description best adapted for its work.

The above, I trust, will be found to answer the questions submitted to me, and in the order in which they were put, and will, I hope, yield the information sought; but, as every harbour has some peculiarity, either in its form, situation, management, or mode of doing business therein, it may not be deemed amiss, perhaps, if I conclude this Report with a few observations touching the subject generally.

The chief peculiarity of Waterford Harbour, relative to its situation and form, is, that it has no *bar* properly so called, but is entered from the sea by a fine, deep, open channel, between the Hook Point and Dunmore, which continues for a distance of seven miles in a direct (true) north direction up to Duncannon Fort, having, with one exception only for a short space, upwards of three fathoms' depth at low water, and has of late been very much improved by an additional light at Duncannon Fort, by which means the two now serve as leading lights up the harbour for all vessels within the Hook Light.

The exception above mentioned to there being three fathoms' water at low water up to Duncannon, is a shoal in the channel or sailing course about a mile and a-half below that place, and is, I believe, technically called the "Bar," however much it may differ in situation and circumstances from the bars which usually obstruct the entrance to a harbour.

At the time I was there, June the 12th, at low water there was 14 feet water over this shoal, in a line with the Duncannon lights; and as that was at a time only two days after the lowest spring-tides, I should deem 14 feet to be less than the usual average of depth over the shoal at low water—that is, there is much oftener more than 14 feet over it than less. Still, I think it very likely, that under very favourable circumstances for producing low tides, the water may ebb out occasionally to 13, and, on rare occasions, to 12 feet; although the average depth at low water may be 14 feet, and upwards.

Should it be deemed of importance to reduce this shoal so as to form a channel with three fathoms, under ordinary circumstances, in the line of the lights, I have no doubt of its being easily effected, and at a very moderate expense; this, together with three feet more in the channel-way of the Ford, would, in my judgment, make the navigable approach to the city of Waterford as complete as could reasonably be desired.

At the quays of Waterford, that which most strikes a stranger is the mode of communication between the quay-side and the ship's side, by means of a bridge, one end resting on the quay, and the other on a floating vessel or hulk, alongside which the steamer, or other vessel, lies to receive or discharge her passengers or cargo; and with this manifest convenience, that the deck of the vessel is at all times on the same level, with relation to the deck of the hulk which serves as a quay, rising and falling with the vessel.

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This mode of doing business, which at first originated in necessity, from the increase of the mud preventing vessels approaching close to the quays, has gradually grown to such an extent, and become so interwoven with the habits of the people engaged in the shipping business of the port, and been found to possess so many advantages over lying alongside a fixed quay, particularly for steamers, that I very much question whether the system would be laid aside, even if the present low quays and muddy shore could be suddenly transformed into a fine stone quay, with 12 feet at low water, in which vessels would be afloat close to the quay at all times; and from what I have had an opportunity of observing and inquiring into relative to the subject, I do not think I should be disposed to recommend it.

What I should recommend (provided the float and bridge system be retained) is, that it should be carried on upon some simple and uniform plan; that floats should be gradually built for the purpose (as others wear out) of a uniform size and form best suited to the objects to be obtained; and that some definite plan should be adopted with regard to the bridgings, moorings, and fastenings, which, I am satisfied, might be contrived with more strength and efficiency, and much less lumber and confusion, than obtains at present; and if a regular system be ever established for the building and maintenance of these floats, I have no doubt but that iron will be found the best, cheapest, and most desirable material to construct them with.

There is no necessity that these floats should be like the hull of a vessel or boat; for, as not having to go through the water, they do not require fine ends; but, on the contrary, they require to have an equal and uniform bearing from end to end, with the deck in the form of a parallelogram—straight sides, and square ends—as being the most convenient for use; and it was the capability of giving a more convenient, useful, and manageable form to the same quantity of materials, that induced me to suggest the propriety of investigating whether the "Olbers" could not be broken up and rebuilt into two or three useful and manageable floats, more economically in proportion to their utility, than by paying 700*l.*, or upwards, to cut her into two large, ill-shaped, and unmanageable floats of her present form and size.

As regards the permanent improvement of the harbour along the quays, the question lies between the erection of a turnwater, and the removal of the accumulated mud by means of a good dredging apparatus, presuming that, in either case, the "floating quays" (as they may be termed) would not be dispensed with.

Building a new quay further into the river I deem to be inexpedient, because it would not remove the cause of the evil, although it might, in some degree, lesson its effects. It would be too expensive; and, if even built deep enough for vessels to lie afloat close alongside at low water, would not, in my opinion, supersede the floating quays.

Should it be found expedient to run out fixed quays further into the river for the use of the coal-trade, timber-trade, or other business not requiring "floating quays," care must be taken not to project them out solid, as that would give the quays below a still greater tendency to fill up with mud; but to support a stone or wood platform, upon piles and bearers of wood or cast iron. By this means a quay of any length might be run into the river with very little impediment to the current, and which would admit of a channel being kept in front of it sufficient for vessels to lie afloat at all times.

On the whole, I am of opinion, that the most immediate effects may be produced, at the least outlay of money, by the establishment of a good dredging apparatus, and a good system of working it; for, by that means, it is certain the present accumulation of mud *can* be cleared away, and that in a shorter or a longer time, according to the means of the commissioners for carrying on the works; and then, when once cleared away, the necessity or expediency for the erection of turnwaters, or other permanent works, for keeping it away, will be shown, and governed by the subsequent annual cost of dredging.

W. CUBITT.

No. 54.

Capt. VETCH, *on the Strands of Tramore and Cunnegar.*

1st December, 1840.

No. 54.
Vetch, on the Strands of Tramore and Cunnegar.

The bay of Tramore is situated on the south coast of the county of Waterford, nearly due south from the city, and at a distance of seven English miles in a direct line. Its extreme length in a north-west and south-east direction, is two miles and one-eighth, and its extreme breadth in the opposite direction, is somewhat more than a mile; and the whole surface, at high water of spring tides, comprises an extent of 1,788 English statute acres; this is supposing the inlet to be bounded by a line drawn across the entrance, where narrowest. This sea-lake is bounded by shores chiefly consisting of low cliffs or banks of clay, and marsh land, the former being in a state of considerable waste, from the action of the tides. This lake is bounded on the side towards the sea by a strip of sand similar to what has been described when treating of the previous lakes; the eastern half, or one mile in extent of this sandy boundary next the entrance, is covered with hillocks or burrows of considerable altitude, while the western half is nearly bare, over which the sea occasionally breaches in stormy weather and at high water of spring tides; generally speaking, the tide land of the bay may be assumed to be covered to a height of from four to five feet by a high water of ordinary spring tides, which at the entrance have rise and fall of about 12 feet.

The channel of the Rhineshark forms the only opening to the bay, and has a breadth of only 113 yards at low water, and 322 yards at high water; the greatest depth at low water being 13½ feet, and the greatest depth at high water 25½ feet; the tide rushes through this entrance with great violence, and Mr. Bald, from whom I have quoted the above dimensions, states the influx of water at half-flood to be at the rate of 4·8 feet per second, and the reflux at half-tide to be at the rate of 5·59 feet per second; the depth of this channel, and the velocity of the tide, get suddenly checked a short way within the entrance, where, from the expansion of the lake, the stream becomes dilated.

The project of embanking the Back Strand of Tramore has long been a favourite one; Mr. Ryland, in his History of the County of Waterford, has dedicated sixteen pages of his work to this subject, where he alludes chiefly to the plans of William Hughes, Esq.; his description is accompanied by a sketch of the back strand, showing three several lines of embankment: No. 1, running from the sand burrow immediately across the Rhineshark Channel, at the narrowest part of the entrance; No. 2, proceeding from the sand burrows at the entrance to the projecting point of land adjoining Crobally Pill; and No. 3, proceeding from the same point to the glebe of Kilmacleague. Mr. Ryland's work

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was published in 1824. Since my visit to Tramore Bay in October, 1840, I have had the perusal of Mr. Hughes's original plan, dated September, 1807, on which three lines are laid down; and in respect to the third line running from the sand burrow to the glebe land and old church of Kilmacleague, I find marked upon it—the best line of embankment; and it is satisfactory to me to know, that previous to seeing Mr. Hughes's plan, I had, from careful inspection of the ground, come nearly to the same decision

Mr. Bald, Civil Engineer, surveyed the Back Strand of Tramore, and made a report on the subject of embanking it; abstracts from which have been published in Nos. 8 and 10 of the "Civil Engineer and Architect's Journal," and I have to express my obligations for the useful information I have obtained from it.

Mr. Bald seems to have adopted a line of embankment nearly coinciding with the line No. 2 of Mr. Ryland's sketch; that is, connecting the point of the sand burrow with that near Crobally Pill; and so far I have adopted the same termini as Mr. Bald, but having the main direction of the embankment in the line selected by Mr. Hughes. I have not ventured, however, to commence my embankment exactly at the eastern point of the burrow, but have retired it about 250 yards westward, inside the bay, as a matter of security; from thence, I proceed in the direction of the ruined church of Kilmacleague; but instead of proceeding the whole distance in that direction, I turn off with an angle opposite to Crobally Point, and there terminate. My objects in selecting this line, are, in the first place, to conduct the embankment on high ground, and somewhat retired from the force of the tide. I have also contrived to cross two channels at right angles, which produces a saving on the average height of the embankment, and renders it more secure. The embankment, according to my project, incloses 1540 English statute acres of tide land, besides sixty-two acres that were formerly embanked, but are now again exposed, making a total of 1,602 acres. The portion of the lake which I have omitted to embank contains 186 acres, but of which a considerable portion, if embanked, would be unfit for tillage; besides the main embankment which I propose, 1,730 yards long, it would be necessary to secure 1,600 yards of the western portion of the main strand, which I have already described as being bare of burrows, and over which the sea occasionally breaches. The necessity of this work has been pointed out in Mr. Bald's report. The remaining works to be executed, are three culverts with sets of sluices, two in the main embankment, and one between the back strand and the fore strand, near the west end of the bay. For the purpose of discharging the drainage, several main drains will also be required, and the diversion of such streams from entering the lake, as circumstances would conveniently admit of.

The rise and fall of the tides, on this part of the coast, being considerable, I do not expect there will be any necessity for the application of steam power, owing to the facility thus afforded by the tides for sluice drainage.

The Cunnegar Strand of Dungarvan

Is situated on the south coast of the county of Waterford, and forms a small gulf or inlet of the sea proceeding from the bay of Dungarvan.

The approach by sea from the outer bay, to the town and quays of Dungarvan is by a narrow entrance or mouth, having an east and west direction. A short distance within this entrance, the main channel separates into two, which branch off into opposite directions, north and south: the first leads to the quays of Dungarvan and to the river Colligan; the latter leads to the Cunnegar Strand or Inlet, which is of considerable extent, but shallow and dry at low water: the bed of this sea-lake consists of slobs or mud-lands, and the idea of reclaiming it from the tides has frequently occurred.

This sea-lake extends southward from the entrance, for the distance of about one mile and three quarters, with a mean width of a mile nearly, the south shore lying in the barony of Decies within Drum, and the west shore in the barony of Decies without Drum.

The north end of this inlet is narrow, being less than half a mile wide; but it suddenly expands, about a quarter of a mile from the entrance, to double that width; and on the south-west, it terminates in a fork, which receives the river Bricka.

On the east side, the Cunnegar Inlet is separated from the open Bay of Dungarvan, by a long, narrow, straight spit of sand; which, in some places, is elevated only a few feet above the high-water mark of spring tides; but in the other places, it is covered by hillocks of sand or burrows, some of them 20 feet high: about the centre of this spit of sand, the width becomes considerable, and contains some buildings, and a little land in cultivation.

The whole length of the sandy barrier, which divides the inlet of Cunnegar from the open bay is 2,787 yards, of which there is an aggregate space of 630 yards, over which the surf passes in storms at high water of spring tides; and for this distance it would be necessary to construct some work to protect the land which is proposed to be reclaimed from the inlet. I do not, however, consider that this operation would be either difficult or costly, as the action of the wind and waves is to throw up sand on the spit, and strengthen it; and indeed it owes its origin to that natural action. The time no doubt was, when this natural barrier, or embankment, did not exist, and when the Inlet of Cunnegar formed but a portion of the great open Bay of Dungarvan; and were this barrier now removed, in whole or in part, by any unusual occurrence, the causes now at work would, in all probability, soon restore it.

The south and west shores of the Cunnegar Inlet are composed chiefly of banks or low cliffs of clay, and occasionally by marsh land. In respect to the first, it is under a process of considerable waste from the action of the tides, as may be seen in several places, by the undermining of the fences.

My opinion is, that the greater part of this inlet may be embanked, and the land reclaimed from the tides, with great prospect of advantage, by means of a line of embankment, which I should propose to run across a short distance south of the entrance, near the point where the lake suddenly expands in a westerly direction. To construct a line of embankment further north would run it into a lower level, without obtaining much additional land. On the other hand, to construct one further south would double its length, and exclude a considerable extent of ground available for tillage.

The proposed embankment is 852 yards in length, and incloses a space of tide land containing 963 English statute acres, extending north and south one mile and a half, and east and west one mile nearly, of mean dimensions.

The river Bricka, and some other streams at the south-west corner, supply a considerable quantity of water, and the diversion or embanking of these, to prevent their flowing upon the reclaimed land, would be attended with some difficulty and expense.

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Having thus given you, at some length, my views on the works necessary for the reclamation of the several lands which appear to me at present worthy the expense of being reclaimed, I hope they may be considered useful to the parties interested; and I shall be glad if I can afford them any further information or assistance in the matter.

I refrain from making any remarks on the value of the land proposed to be reclaimed, or of the advantage to be derived from the undertaking generally, as subjects lying more in the province of the able agriculturist who accompanied me in my tour of inspection.

I have, &c.,
JAMES VETCH, *Civil Engineer.*

To Messrs. Deans and Dunlop,
23, *Fludyer-street, Westminster.*

No. 55.

No. 55.
Frazer, on the want of Lights, Buoys, and Beacons on the Coast of Ireland.

Captain FRAZER, R.N., M. R. I. A., *on the want of Lights, Buoys, and Beacons on the Coast of Ireland.*

H. M. Surveying Vessel, "Lucifer,"
Waterford, Dec. 28, 1845.

SIR,

Taking into consideration the great and increasing traffic on account of steam communication, and what may still further be expected, when Ireland shall, at no distant day, become intersected by railways, and her piers and harbours improved, there is, it appears to me, no subject more deserving attention and observation than the lights and buoys of this coast, both of which, even admirably as the former may be managed in detail, are lamentably deficient, both in number and position. I feel it a duty, therefore, to beg your attention to the following observations, as they have occurred to me relative thereto.

In the first place, the whole of the banks and shoals from Dublin southwards to the Tuskar, a distance of upwards of 70 miles, require buoying. At present there are but seven buoys to mark all these extensive shoals, viz., one on the north end of the Kish Bank, and one on its south end, which marks the swatch between it and the Bray Bank; one on the south end of the India Bank; one on the north end of the Arklow Bank; one on the north-east end of the Glassgorman Bank; and one at each end of the Blackwater Bank. These are quite insufficient, and to mark these shoals as they ought to be, it would require at least eleven additional buoys or beacons; for instance, independent of those named above, there should be one on the south end of the Bray Bank, and another on the north-eastern extreme of the Codling Ridge: these two would sufficiently mark their limits, as well as the deep swatchway between them.

There should be one on the north end of the India Bank. On the Arklow Bank it would require two to mark the swatchway across it. On the Wexford Banks, there should be one on the outer end of the Rusk, and another on the inner end of the Moneyweights; these are much wanted, as no marks can be here established as a guide to lead inside the banks.

On the Long Bank there should be two buoys, one at each end; these, with one on the Lucifer shoal, and another on the inner extreme of Holden's Bed, would make the navigation into the north and south bays of Wexford simple and easy.

A buoy on the outside of the Collough Rock, off Carne, and another off the Barrels (half-tide rocks between Coningbeg and Tuskar) would be extremely useful. Less than what I have here named would, I think, be insufficient, and for want of them much valuable property and life has been sacrificed.

I shall now say a few words respecting the lights on the east and south coasts of Ireland. First, it must be evident to any person acquainted with the east coast, the great necessity for a light vessel, somewhere in the neighbourhood of the Blackwater Bank, the distance between the Tuskar and Arklow Light-ship (33 miles) being too great. The lamentable loss of life and property on this bank is evidence sufficient to prove this great necessity.

The Coningbeg light-vessel, to the westward of Carnsore Point, is not by any means what it ought to be for the important position it is placed in, being, as it were, the guiding star into the Irish Channel: had it been more decided in its character, it would have warned many vessels and saved many lives which have been lost between it and the Hook. Indeed the dangers in this neighbourhood, and they are considerable, will never be properly lighted till this light is exhibited from a fixed building, which is intended, but the work progresses very slowly. The present light-ship in many cases is almost useless, on account of her rolling so heavily, her lanterns being too weighty for such a class of vessel, where the sea is at all times very heavy; she is mostly obliged to have her after sail set to keep her head to sea on this very account.

On the south coast a light is much wanted, somewhere between Waterford Harbour and the entrance into the Cove of Cork. I think Cable Island would be the best position, as there it would be found not only useful to the coasting trade, but also very much so to Youghal Harbour, which promises at no distant period, taking into account contemplated improvements, to become a place of extensive traffic.

From Cape Clear round to the westward there is much yet to be done in the way of lighting, before it can be said to be perfect in that respect; and, in the first place, it is much to be regretted that the light on Cape Clear should have been placed at such an altitude as 455 feet above the sea.

It is a well known fact, and I speak from long experience, that during thick weather, which is very prevalent on this coast, the Cape is visible frequently when the light is not, and I cannot help thinking it would have been much more judiciously placed on the Fastnet Rock, in every point of view, standing so prominently forward as it does from the coast.

There should also, in my opinion, be a light on the Bull Rock; the distance between that on Cape Clear and the Skelligs, namely, 50 miles, being too great; this, with a harbour light at the western entrance into the splendid harbour of Berehaven, would make its access easy, whereas the difficulty of making it at present is proverbial.

Again, a light is sadly wanted on the Foze Rock: this, the outermost of a dangerous cluster of rocks, is much dreaded by mariners bound to and from the Shannon; the distance between the Skelligs and Loop Head Lights being upwards of 56 miles (in a direct line), and the Foze Rock lying eight miles outside their line of direction.

It appears to me, that if these lights were placed as suggested, viz., on the Bull and Foze Rocks, which are the extreme of the dangers, situated at the entrances to the great bays of Dingle, Kenmare, and Bantry, it would be thereby so well marked that the present anxiety in navigating or making this coast would be greatly done away with.

The north-west coast of Ireland is also deficient in respect of lights, there not being one between Eagle and Tory Island Lights, a distance of 86 miles, excepting those within the bay of Donegal, which, however useful and necessary where they are, are still useless to the general navigation of the coast; however, as the traffic of Donegal Bay, which embraces Killybegs, Donegal, Ballyshannon, Sligo, and Killala, increases, which undoubtedly it will as the resources of the country are opened up, it will be found necessary to have two additional lights in this bay, one (which, indeed, would be useful now) on Rackliburn Island, and another on the south side of the bay, somewhere in the neighbourhood of Downpatrick Head.

On the north coast, I would suggest the necessity of placing a light on the north or north-west extreme of Rathlin Island, the distance between Innistrahul and Mull of Cantire Lights (51 miles) being much too great. A light here would be extremely useful as a guide into the Irish Channel, which is dangerous at

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all times, on account of the tides in that neighbourhood. A beacon also on the Carrickvanan Rock, directly in the track of steamers to and from Londonderry, is too obvious to need mention.

A glance at the map will at once, and perhaps more clearly explain the above positions, and the reasons for these suggestions, which arise from long practical knowledge of this coast, and from the experience gained in the course of the last 20 years, during which I have been employed on the survey of upwards of 1000 miles of the shores of Ireland.

GEORGE ALEXANDER FRAZER, *Commander.*

Captain Beaufort, R.N., F.R.S., D.C.L.,
Corr. Inst. France, Hydrographer.

No. 56.

Strangman on the Fisheries of Waterford and Dunmore.

No. 56.

Extract from a Letter from MR. J. W. STRANGMAN, *respecting the Fisheries at Waterford and Dunmore.*

Waterford, 26th of 3rd Month, 1844.

THE fishing ground on this coast is excellent, and since its value has been fully ascertained the number of boats engaged in fishing has greatly increased; and the pier at Dunmore affords such superior accommodation, that it bids fair to become an important and valuable fishing station. At one period this year we reckoned upwards of 20 cutters, of 40 to 50 tons each (some from Dublin and some from Dartmouth), besides the local boats; and it is a remarkable and, at the same time, a very gratifying circumstance that, since having so many assistants in gathering this rich harvest, the quantity of fish caught by our boats does not diminish, but the contrary. In proof of this I may state that when we commenced, about a year and nine months ago, we considered 40*s.* worth a good day's fishing; but now, unless it produces 3*l.* or upwards, we look upon it as only "so so."

Another pleasing feature is that the demand keeps pace with the supply; England takes all the surplus prime fish, and the other descriptions are now becoming a regular portion of the diet of the inhabitants, and is found not only wholesome but likewise economical. The cod of 12 lbs. to 30 lbs. is ½*d.* to 1*d.* per lb., and haddock of 8 lbs. to 14 lbs., 2*d.* per lb., is as good and cheap food as need be desired. The great value of the fishery on this coast has surprised many persons; and as figures in statistics are potent arguments, I may here mention, in the hopes that the knowledge of it may perhaps have some little weight in inducing those in authority to foster and encourage so valuable a branch of industry, the produce of our boats for the half-year ending the 1st of this month, viz., the fish caught in that period by boat No. 1, sold in Waterford for 217*l.* 9*s.* 6*d.*, and after deducting the expenses, say carriage, commission, &c., the men received 111*l.* 14*s.* 6*d.*, and the owners 83*l.* 15*s.* 10*d.* The gross earnings of boat No. 2, in the same period, were 180*l.* 4*s.*, and after deducting the like charges, the crew had 91*l.* 14*s.* 2*d.*, and the owners 68*l.* 15*s.* 8*d.* Now, if the ensuing six months be as profitable, and we have no reason to suppose it will be otherwise, the crew of No. 1 will earn 223*l.* 9*s.*, and No. 2, 183*l.* 8*s.* 4*d.* in the year, which, divided in the accustomed proportions, will stand thus:—

		£.	*s.*	*d.*		£.	*s.*	*d.*
Skipper, 1 and ½ share, No. 1	.	69	16	6	No. 2 .	57	6	0
2d hand, 1 and ½ ditto	„ .	69	16	6	„ .	57	6	0
3d ditto, 1 share	„ .	55	17	4	„ .	45	17	0
Boy ½ ditto	„ .	27	18	8	„ .	22	18	8
		£223	9	0		£183	8	4

And the owners will receive from No. 1, 167*l.* 11*s.* 8*d.*, and from No. 2, 137*l.* 11*s.* 4*d.*; and if we deduct 50*l.** from the earnings of each boat for wear and tear, and supposing the boats to cost 500*l.* each, which is considerably more than we paid for them (one of 32 tons, and the other 36), No. 1 will pay 23½ per cent., and No. 2, 17½ per cent. in the year, averaging 20½ per cent. And further, if we only supposed there were 20 such boats belonging to Dunmore, and I see no reason why there should not be twice or thrice that number, and supposing them to be as successful as those mentioned above, there would then be a sum of upwards of 4,000*l.* to be divided among the crews of those 20 boats, say 60 men and 20 boys, not to speak of the owners' shares, or the money distributed among the carriers, helpers, basket-makers, &c., besides the annual outlay for sails, cordage, twine, boat-builders, &c. With these pleasing results before them, I should hope the Fishery Board would see the propriety and great advantage of endeavouring to accomplish the two things that are so requisite, viz., to obtain the grant of a sufficient sum of money to erect and maintain piers, where needful, for the shelter and accommodation of fishing craft; and secondly, to remove or relax the absurd restriction respecting the use of the trammel-net by day. Upon the first point, I apprehend it will not be necessary for me to offer any arguments, as the great advantage to fishermen to have shelter, protection, and accommodation for their craft is so very obvious. And although we do not require any outlay of this nature at Dunmore, where the accommodation is so superior, yet there are many other places on the coast where the expenditure of a few hundred pounds would be most usefully and beneficially applied; for example, at Slade, near Hook Tower, and at Bannow, both in the county of Wexford. The contiguity of these places to the Saltees, where there is good cod-fishing, would render them most valuable, particularly for the trammel-net. I confess I am at a loss to comprehend the objection to the use of this net in the day-time, and condemning the parties who use it to labour only in the night season, which, in the winter particularly, a very profitable period, inflicts so much additional hardship, especially to those who shoot such nets in deep water. For, as to the assertion that this kind of net frightens away the fish, surely, if such were really the case, it would long since have had that effect in those places on the coast of England, France, and Norway, where it is in constant use. I do hope, therefore, that the Board of Fisheries will endeavour to obtain the power of relaxing that absurd restriction in all cases where they may deem it expedient, and also that they will solicit Parliamentary aid for building piers. Our Company have sent forward a petition to one of our representatives (T. Wyse) on the subject, and hope it may have a beneficial effect. I should not omit to mention that we have been applied to, to form a branch of our establishment in the county of Wexford: some of the fishermen there being desirous of participating in the improved modes of fishing, and not having capital to begin themselves. If the trammel-net restriction were removed, and piers built there, it is most probable we should comply with their wishes; as that and lobster-fishing are the best suited for that situation, Dunmore being the best for trawlers.

Yours, &c.,

J. W. STRANGMAN.

ESTEEMED FRIEND, *Waterford, 24th of 2nd Month*, 1846.

I have to acknowledge receipt of thy favour of 20th inst., and in accordance with thy wishes to learn something more of our fisheries. I have to state that there are 12 cutters of 36 to 50 tons each, now belonging to Waterford, and stationed at Dunmore. Our Company has three, four other parties two each, and one

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* The deduction of 50*l.* for wear and tear is not sufficient. Experience shows it ought not to be calculated at less than 70*l.* to 75*l.*, but then our boats were not new, which may have increased the charge.

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person the other, all engaged in trawl fishing, with a likelihood of a further increase; no falling off in the quantity of fish taken, or the demand for it; no jealousies among the people notwithstanding this increase of boats, nor any grounds for it, as there is a fair open field for each to try their skill, and the best men earn the most money. The gross produce of the fish caught by these 12 boats during the year I estimate at 4,200*l.*, or 350*l.* per boat, of good nutritious food; and a striking proof of the advantages resulting from a safe harbour in the neighbourhood of the fishing ground, and which will be an encouragement to Her Majesty's Government to build piers in other places.

The quantity of fish taken in summer is greater than in the winter; but, in the sale of it, it has to come into competition with salmon, sprats, mackerel, &c., the produce therefrom is not so remunerative. In the year ending 1st September, 1845, the average catch of our three cutters was 370*l.* each; in the last year 365*l.* each; average earnings of each skipper and crew in the same period, 184*l.* Prices of " head fish"—in winter, turbots 10*d.* to 1*s.* per lb., soles 4½*d.* to 5*d.* per lb.; in summer, turbots 6*d.* to 8*d.*, soles 2½*d.* to 3*d.* per lb.

It is very much to be regretted that the Board of Irish Fisheries have not yet allowed us the free use of the trammel-net for the taking of cod, &c., although the Act of last session entitles them to do so. It is a valuable engine, essentially the poor man's mode of fishing, being inexpensive and easy to work. The quantity of cod now on the coast is very great; last week one of our boats took one day in the trawl as many as seven dozen, many of them very fine fish, some weighing 34 lbs. to 36 lbs. each, and which were sold at ½*d.* to ¾*d.* per lb. Fine haddock also of 10 lbs. to 14 lbs. each. At this juncture too, on the eve of Lent, and when the potato, the staple food of the poor, is so rapidly decaying, it is much to be lamented that the unwise and very singular restriction respecting the trammel-net is not removed. Immediately after the passing of the Fishery Act last session, I wrote to the Board requesting permission to introduce it in these parts. In reply, I was called upon to define the size of the mesh, and the exact localities where we proposed to use it. I mentioned six inches from knot to knot (hoping to remove all possible objection), and also stated that the exact spot would depend so much on the currents and the haunts of the fish, that experience could alone decide the precise places, but I proposed trying between the Saltees and Great Newton Head. To this last communication I have had no reply. I am aware that the Board have a great deal of business to perform, being also Commissioners of Drainage and of Public Works, and therefore no wonder that our small concern should have lain by; but, with the present deplorable decay of the potato, I cannot but additionally regret it. I had, indeed, some thoughts of writing to our late excellent chief secretary, Sir Thomas Freemantle, on the subject, knowing the warm interest he takes in the promotion of the deep sea fishery, but I felt reluctant to intrude upon him, being aware of the numerous demands on his time. I should be glad to see the deep sea fishery left wholly free and unrestricted, both as to the kind of net and size of mesh. For river fishing regulations are needful, but as regards sea fishing, where to be profitable the great object is to take the largest quantity of fish, with the least expenditure of labour and capital, I confess I cannot understand why there should be any objection to the introduction of improved modes of fishing. Is it not as unwise as if there were legal impediments to the adoption of improved machinery in manufactures or agriculture? I should also be glad to see the Fishery Board freed from such a multiplicity of varied and rather unusual engagements, and if they had inspectors to make periodical visits, and explain to the fishermen the improved modes of fishing, and the advantages that result from pursuing a judicious system, it would have an excellent effect, for Paddy requires a stimulant of this nature; and if there were some little books printed on the subject they would be very useful, and would likewise prove a valuable addition to the libraries of the national schools on the coast.

I find I am travelling rather out of my proper province in thus entering on such matters; before, however, I conclude, I would wish respectfully to submit one other matter for thy consideration, which has at different times occurred to me. It is whether something might not be done to establish a fishery on the Nymph Bank. This Bank, thou art doubtless aware, lies at 40 miles to the southward of this harbour, and tradition has it that it is well stocked with cod, ling, and other fish. Our Company have at different times been considering about making a trial there, but as it would require a different sort of boat to those for trawling, and at least six would be requisite to work it systematically, which would cost with their outfit and gear from 800*l.* to 1,000*l.* each, it appears rather too hazardous to embark in such an undertaking without some clear, correct, and definite information on the subject; would it therefore be practicable to prevail on the Government to send one of their surveying ships to examine and report upon its nature, extent, and position, depths of water, currents, &c. If they could also be induced to charter, suppose three or four of the London cod smacks (vessels employed in supplying the London market from the coast of Norway), to come and fish this Bank for three or four months, it might, if their report were favourable, prove of great and lasting advantage, not only to this port but also to Dungarvan, Youghal, and other contiguous places; and if unsuccessful the expense would not be felt by the Government.

Yours, &c.,

J. W. STRANGMAN

Capt. Washington, R.N.

No. 57.

DUNMORE HARBOUR.

No. 57.

Telford's Report on constructing a Harbour at Dunmore.

A Copy of the Report of Mr. THOMAS TELFORD, *dated* 10*th February*, 1821; *and a Copy of a Report of* Mr. ALEXANDER NIMMO, *dated 20th February*, 1821, *upon the Works of Dunmore Harbour.*

(1).—MR. TELFORD'S REPORT.

SIR,

Bangor Ferry, 10*th Feb.* 1821.

Agreeably to your directions, I proceeded to and examined the works at the harbour of Dunmore. They have now been carried to a very considerable extent, and into upwards of 30 feet depth of water, at low water of ordinary spring tides; they have been performed in a manner which reflects equal credit on those who planned and those who conducted and more immediately superintended the sundry operations. The performances, by means of the improved diving-machine, contrived by the able engineer, Mr. Nimmo, will be an excellent model for similar works where a great depth of water is required, or where rocks are to be removed under water. The Resident Manager, Mr. M'Gill, has by sagacious conduct and unremitted exertions, not only pushed on the works generally with regularity and despatch, but has brought the diving-bell operations, in great depths, to a degree of simplicity, safety, and celerity, which is scarcely credible, the workmen actually preferring them to the works above high-water mark. All that relates to payments and pecuniary concerns has been equally well conducted by Mr. Robert Grubb, under the direction of the General Post-office.

But having now not only provided effectual protection and accommodation for the packets, but also for the revenue and trading vessels of great draught of water, and as any further extension in so great a depth of water, with occasional interruptions from violent storms, would be attended with much trouble and expense, I therefore recommend that the engineer be directed to take the necessary

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Telford's Report on constructing a Harbour at Dunmore.

measures to complete the works now on hand with all practicable despatch, and without attempting any further extension.

Although the harbour protection will be very complete, the accommodation for passengers, after landing, will still be imperfect, until a comfortable inn or hotel has been constructed near the landing-place; and for such an establishment there is ample space on the cleared ground on the north side of the high ridge of rock, which forms a desirable protection not only to that space but to the harbour itself.

I cannot close this Report without stating, that when the works have been completed as here recommended, a very valuable station will have been acquired in a very important point of the coast; and this, whether we regard the port of Waterford, and the fertile districts to the north and west of it, the occasional protection to the revenue cruizers and general coasting traders, or to the connexion with the south-western parts of England. The accommodation will also be sufficiently extensive for all that can be at present contemplated, and if increased prosperity requires more, the present termination offers no obstruction to extending the works to meet the greatest possible demands.

THOMAS TELFORD.

Edward S. Lees, Esq.

No. 58.

Nimmo's Report on a Harbour at Dunmore.

No. 58.

(2.)—MR. NIMMO'S REPORT.

Dublin, 20*th Feb.* 1821.

DURING the season 1820 the rough mole of the pier at Dunmore has been carried out nearly to the extent proposed. The storms of December have brought it to the slope and firmness proper for receiving the pavement on the sea front. The quarrying for this pavement will, during next season, furnish all the additional rubble-stone requisite to complete the extent estimated for.

I would not recommend any further extension of this mole until the benefit of the harbour be more fully experienced; and I have reason to believe the estimate formerly furnished will cover all the expense of completing the pier in its proposed dimensions, viz., 42,500*l.*

Of that estimate, two grants of 12,000*l.* each have been already voted by Parliament, leaving a balance of the estimate of 18,500*l.*

Ten thousand pounds are required to carry on the works during next season. These works will chiefly be the completion of the pavement and parapet on the sea side, and the wharf wall on the inside of the mole, for which last work it has become necessary to procure proper stone (especially for the diving-bell part), at some miles distance up the haven, the quarry in the neighbourhood of the pier being nearly exhausted.

For further information as to the present state of the harbour, I beg leave to refer to the Report of Mr. Telford, who has lately visited the works at the request of the General Post-office, and which Report I understand has been transmitted to Government.

ALEXANDER NIMMO.

Irish Office, London, 7*th May*, 1821.

No. 59.

Coota and Nimmo's Report on a Harbour at Dunmore.

No. 59.

Messrs. COOTE and NIMMO'S *Report on the Practicability of forming a Packet Harbour at Portcallin Cove, near the village of Dunmore, in the county of Waterford.*

4*th March*, 1825.

WE have the honour to report, for the information of Government, that in obedience to our instructions to proceed to Waterford, and examine the practicability and expense of making a pier harbour for the accommodation of the Milford packets, at a lower part of the haven than their present station at Check Point, we visited in succession the sites of Dunmore, Credenhead, Passage, and Check Point; and having made the necessary observations at low water spring-tides, taken soundings, and consulted the most intelligent mariners, we are distinctly of opinion that the Cove of Portcallin, or Port Sally, near Dunmore, is the most advisable situation which the haven affords; that it is capable of being formed into a good pier harbour, for the accommodation of the packets on that station, may be entered and departed from at all times of tide, and is likely to be of material advantage to the trade, not only of Waterford, but of the empire in general.

It may be proper to observe the importance of this harbour, particularly to the naval station at Cork, as despatches would be transmitted between that port and the arsenals in Great Britain, generally in one-half the time which is necessarily taken by the way of Dublin; its value in securing a communication between Great Britain and Ireland, in all weather, must be obvious, from this circumstance—that in the late snow the Milford mails were regularly transmitted through all the south of Ireland for 12 days, after the communication with Dublin had been cut off.

We have prepared a design and estimate for this harbour, as also an enlarged chart of the mouth of Waterford Haven, on which its situation is correctly laid down, that the position, with respect to the neighbouring land, may be better understood.

The south-east side is a steep cliff, with a low shelf of rock at its foot, nearly at the level of high water, and about 50 to 60 feet in breadth. We propose to cut away this shelf to a road or wharf 30 feet wide, with an upright quay-wall in front.

On rounding the point of the cliff, we retire 100 feet to the eastward to enlarge the mouth of the harbour, where we commence a mole of large rubble stone nearly in the same direction, viz., somewhere within the point of Ardnamult, and carry it to the distance of 250 feet from the cliff; this shuts in the Hook point on the opposite rock of Elan-na-gliogh, which we propose to form the northern side of the harbour.

From hence we run an arm to the N.N.W., or about 120° inclined to the former, for 100 feet, and are then about 200 feet from the point of rock of the Elan-na-gliogh; but as this space of 200 feet would be too wide an entrance for so small a harbour, and would expose it too much to the north-easterly winds, we propose to contract it to 150 feet, either by the prolongation of the arm, or by a short mole from Elan-na-gliogh, as that will keep the mouth of the harbour more to seaward, in deeper water, and cleaner ground.

These moles will be 40 feet broad at low water, sloping three to one on the outside, and as little as possible on the inside. They may be formed of the conglomerate and red sand-stone of the neigh-

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No. 59.

Coote and Nimmo's Report on a Harbour at Dunmore.

bouring cliffs, which may be had in large blocks, and much of it now loose and ready to be transported. The heads are not exposed to a great sea, may be narrower, of large blocks, in regular courses, and the points (if need be) laid in caissons.

On the mole is to be built a pier of coursed masonry on either side, filled with rubble, and paved or coped with square stone, having a parapet five or six feet high, with a projecting cordon at bottom to throw off the spray. The pavement of the pier to be four feet high above high water springs.

A light-house must be built on the south pier-head, a transporting buoy laid outside of the barbour, with capstans on the piers, for warping out by it in foul winds; a bridge will be also necessary into Elan-na-gliogh. With these accommodations, a vessel may depart from this harbour with any weather that will admit of her putting to sea. The only winds which will require warping are from the north-east, and they never raise any swell in the haven.

With regard to gaining the harbour, it must be observed that little or no stream of tide is felt in Dunmore Bay; and the only case in which there can be much difficulty is with south-westerly winds, during which the vessel may anchor safely under shelter of the high cliffs surrounding Dunmore Bay, until a hawser be passed to the piers; or, at worst, may bear away and run up the haven to Passage, where she is in security until she can regain her station at Portcallin, for this should be at all times her point of departure. It is admitted by the captains of the packets, that it would save, on an average, one-third of the time of passing to Milford, and in many cases even entire days.

The harbour, according to the design, contains at low water three English acres and a half, and four and a half at high water: of this, about two and a half will have at low water-springs from 9 to 15 feet water on clear firm sand. The mouth of the harbour will be in 16 to 18 feet water; one acre more will have 9 feet or less, a small part of it flat rocky ground, which may be cleared out; and one acre more will be added at high water, exclusive of any excavation, so that, upon an emergency, from 20 to 30 vessels may be accommodated.

As the tide rises 11 or 12 feet, there will be at high water 25 feet within the heads; therefore this harbour may be approached and entered by ships of considerable burthen. It will also be of great value to all vessels navigating St. George's Channel, as a station for pilot-boats to be constantly afloat; at present, they are often prevented from getting out beyond Creden Head; and it may be observed, that there is a valuable herring-fishery in Dunmore Bay, which suffers much from want of shelter for the boats, of which at least 100 may be secured in Portcallin, without being in the way of the packets.

The Secretary of the General Post Office, in his report, estimates the increase of revenue on the postage of letters between the harbour and the city of Waterford at 3,000*l.* per annum; and we are informed by the merchants of Waterford, that duplicates would be sent of the trading correspondence from the southern ports of Ireland, when so secure and expeditious a conveyance of the mails would be effected.

CHARLES COOTE.
ALEX. NIMMO.

No. 60.

MR. G. HALPIN *on the damage caused at Dunmore Harbour.*

No. 60.

Halpin's Report on Damage done to Harbour.

SIR,

North Wall, Dublin, 21st February, 1832.

In compliance with the directions of the Commissioners of Public Works, as communicated in your letter of the 28th January, I have made a careful examination of the works at Dunmore Pier, and have now the honour to state to the Board the result of my observations.

My attention was first directed to the state of the sea pavement of the mole, which has been broken up and breached through almost its whole length, those breaches are widening and advancing towards the parapet every storm, and have at the northern or pier-head breach approached to within nine feet of the string course under the parapet. During my stay at Dunmore, this and the other breaches were partially enlarged by heavy sea from the south.

The cause of this great breaking up of the pavement is to be found in the insufficiency of the base given to the back of the mole, which in few places extends 160 feet from the line of the parapet wall, and in parts declines so abruptly as at a fall of one foot to one. This base can never have been sufficient, for the sea could have little or no power to remove heavy stones at the depth in which the outer edge of the backing is laid—from 22 to 27 feet under the level of the low water of spring tides; nor were the stones immediately at the end of the paving sufficiently packed or levelled home to it, allowing the sea to underwork and hollow beneath—this process preceding every enlargement of the breaches. Had this portion of the work been sufficiently extended, a small annual outlay would have prevented the back of the pier being in its present ruinous state.

The paving at the head of the pier has not been much injured; a quantity of the pavement and of stones, which were laid at the back of the pier for its repair, have been washed round here, all the smaller material being swept into the angle of the jetty, which now dries to its northern extremity at the low water of spring tides—a filling up of better than 20 feet which projected into the harbour, but to no considerable extent.

To place the seaward side of this pier in a state likely to be durable, the base should be enlarged to a width of at least 200 feet from the line of the parapet wall, and made throughout its length of a uniform section.

The sea or pitch pavement should be carried to a breadth of 70 feet from the line of the parapet, and great care taken in the execution of this work; also in the levelling or packing the stones between it and the low water mark.

Rubble blocks for the backing may be had from the different points lying north of the pier—Badgers Lair, Net Pool, Strand Burn, distant from three to four furlongs by water carriage; some blocks for the paving may also be obtained from these points, but the flat rocks under the western quarry, and the quarry opened on the Commissioner's property near the forge, afford more durable stone for the pitch pavement. The expense of procuring stone from the latter quarry would be less than from the others, and the working it would, as recommended by Mr. Nimmo, lower that ground, which could afterwards be levelled and usefully laid out for coal-yards, stoves, light-keeper's dwelling-house, and other establishments connected with or dependent on the pier.

I would recommend that the working of these quarries, and indeed every other part of the work, be done by contract; with sufficient care on the part of the resident superintendent, work of that description may well be executed in the most rapid and cheap manner.

APPENDIX B.

DUNMORE.

No. 60.
Halpin's Report on Damage done to Harbour.

There has been a slight settlement in the jetty. This, however, took place shortly after its being built, and in no way effects its stability; it would require to be pointed, as well as the quays, which are otherwise in good repair.

The sea running into the harbour recoils heavily from the slip at the inner end of the pier quay, and strikes vessels lying opposite it under the quarter: it is at one of the packet berths, and considered a great annoyance by the captains of those steam vessels. As this slip is of little present use, it would be better to build it up to the line of the quay.

The inner facing of the parapet wall requires to be finished from the end of the cellars; the cut stone courses for this have already been prepared.

The small square tower on the rock outside Illaan Gleagh was shaken during a heavy storm by the weight of the chain bridge then attached, not from any insufficiency of the foundation; with a few iron bands it would hold together for some years longer, but on the completion of the more important works, it would be desirable to rebuild it circular from low water upwards, and of more than its present height. The removal of the rock on which it stands, unless accompanied by other more extensive rock cutting, could add but little to the facility of entering the harbour; at present it is useful as bearing this guide to vessels passing, and as part of the material breakwater formed by the chain of rocks extending from Illaan Gleagh.

There has been a considerable silting or filling up over the harbour. On comparison of the present depth of water with the sections sent me by the Board, this silting appears to have been since the year 1820 so much as eight feet and upwards along the quays, extending towards the mooring buoys, where the mud on the rock is three feet in thickness; at the lower end of the quay slip, where the depth was 16 feet at low water of spring tides, it is now but nine feet shoaling to the upper end of the slip, where it is nearly dry at low water spring tide. At the inner point of the jetty the depth has diminished ten feet; this, however, from the stones washed round the pier bead—at the outer point more than 20 feet, as previously mentioned. At the east side of the harbour, on rock which had been levelled by the diving-bell, the silt now varies from two to four feet in thickness. The soft portion of the deposit may be removed without difficulty.

The rail or tramways through the quarries near the pier are for the most part capable of immediate use. The branch to the western quarry wants but little repairs; the sleepers in places require to be raised; but a small expense would in a few days put the whole length now laid in working order.

There is also a considerable stock of tramplates in possession of the Commissioners, which will be sufficient for all the additional branches it may be necessary to lay in working the quarries.

For ascertaining the quantity of stones, a weigh-bridge placed on part of the tramway, over which the waggons may have to pass, would be the simplest mode of measurement, and least liable to fraud or error.

Some of the trucks, the shear-poles, blocks, crab purchases, and a quantity of tools are fit for use, and will materially expedite the commencement of the works.

I have not prepared an estimate, nor taken steps for any temporary repairs of the pier, considering that such, if unaccompanied by an extension of the backing, would be of little service, and would be liable to be washed round the pier by the first storm, and add, to the filling up beyond the jetty; nor could measures be taken for such temporary repairs much sooner than for regular operations.

The pitch paving and backing may be completed in two years. In the ensuing summer the works may be so forwarded as to secure the pier from damages by storm.

I concur with the Commissioners in thinking that no addition to the length of the pier is at present requisite, but would impress on them the necessity of carrying to a sufficient extent the repair of the present mole, to prevent the recurrence of considerable and annual expense.

I sent notice to builders at Waterford that the repairs of the pier would be let by contract; some persons have reviewed the work, but as it is likely persons may not be found there willing to become contractors, I would respectfully beg leave to recommend the Board to advertise the work.

Herewith I send plans exhibiting the present state of the pier and harbour, with an estimate of the probable expense of completing the works; copies of a specification and form of proposal, which I drew out and gave for contractors at Dunmore; also an account of the quantity of cut stone, state and quantity of the tramways and tramplates, &c., and return with them the map and papers sent me by the Commissioners previous to my visiting Dunmore.

I have, &c.,
GEORGE HALPIN.

Henry R. Paine, Esq.
&c. &c.

(Copy.)

Estimates for Work to be executed at Dunmore Pier.

		£	s.	d.
35,620	Cubic yards of rubble stone blocks for backing and pitch or sea pavement, at 4*s*. . .	7,124	0	0
2,877	Superficial yards of pitch paving, bedded and jointed with Abertham mortar, at 35*s*. .	5,034	15	0
2,200	Superficial feet setting the inner face of the parapet wall, in cut stone ashlar courses already prepared, at 8*d*.	73	6	8
184	Cubic yards of rubble masonry to back same to the front of the parapet, at 8*s*. . .	73	12	0
90	Superficial yards of flagging between the outer and inner coping or parapet wall, flags already dressed on top, at 1*s*. 6*d*. . .	6	15	0
	For repairing roof of coal cellars, and painting with cement the quays	150	0	0
2,436	Cubic feet of lent stone work for beacon on rock taking down to low water mark, rebuilding it circular to 15 feet over the level of high water mark, at 2*s*. 6*d*.	304	10	0
	Contingencies at 10 per cent.	1,276	13	8
		£14,043	12	4

21*st February*, 1832.

GEORGE HALPIN.

APPENDIX B.

TRAMORE.

No. 61.
Bald, on the formation of a Harbour in Lady Cove.

No. 61.

TRAMORE BAY.

Report by Mr. W. BALD, C.E., *on the formation of a Harbour in Lady Cove, Tramore Bay, Waterford.*

GENTLEMEN, *Dublin, 30th September*, 1837.

The Lady Cove is situate on the western side of Tramore Bay, about five furlongs S.W. by S. of the town of Tramore, which lies close on the edge of the north-western corner of the bay.

The bay of Tramore has been one of the most destructive to man, and also to ships, of any bay on the shores of the British empire. Scarcely a winter passes that ships are not wrecked and lives lost; sometimes as many as five ships have been wrecked in one month. The waste of life and property within this dangerous bay is such as to exceed that on any part of the shores of the British isles. History hardly records a more melancholy event than that of the shipwreck of the "Sea Horse" transport, on the 30th January, 1816, in the bay of Tramore, within one mile of the shore. This transport was bound to India, and had on board a part of the second battalion of the 59th regiment and of which perished 264 non-commissioned officers and privates, also Lieutenant Allen, R.N., 15 sailors, 71 women and children; only 4 officers, 26 soldiers and seamen survived this awful catastrophe out of a crew of 362 persons including passengers.

The commercial and shipping interests of the United Kingdom call imperatively on the executive of the country that this bay, which has entombed so many valuable men, and property to the amount of hundreds of thousands of pounds sterling, should be robbed of its power of destruction by the erection of an asylum or safety harbour. From those circumstances, and the position of Tramore Bay on the southern coast of Ireland, by which so many ships pass and repass continually from the sea-ports on the west of Great Britain bound to North and South America, and the East and West Indies, &c., &c., points it out as a most eligible place for a safety harbour. It has frequently been mistaken by mariners for the entrance to the harbour of Waterford; and such is the power of the indraft and run of the sea into Tramore Bay, that ships falling within its headlands have seldom been known to get out.

The bay is about 2½ miles long by 2 miles broad; but behind the front strand of this bay lies a large plain of sand and mud, called the Back Strand, being 2 miles long by 1½ miles wide, and which is entirely covered at high water. The tide of flood flows through the strait near the Rhineshark Ferry with a rapid current, and covers this plain, producing an indraft into the bay destructive to the mariner who has the misfortune to enter it. The breadth of the strait near the ferry is at high water about 280 yards, and at low tide about 90 yards. The front strand of Tramore Bay consists of a sandy beach of 2¾ miles in length. The rabbit warren or burrow, situate on the eastern portion of the strand, consists of elevated sand-hills, extending along the coast for 1¾ miles. The western part of the front strand is low, and covered with shingle and sand. The western side of Tramore Bay, taken from the town of Tramore to Newtown Head, bears S.W. by W. ½ W., length 2½ miles, and which consists of an iron-bound shore, from 40 to 80 feet in height, formed of compact indurated masses of greywacke rock, in beds nearly vertical, and running parallel with the coast. On this side of Tramore Bay is situate the Lady Cove, and is about three-quarters of a mile from the town of Tramore; also on this side of the bay is situate Ough-a-Iskey, or the Fishing Cove, and also Newtown Cove lying close to it, and are distant from the town of Tramore about 1¼ miles; those coves are creeks formed out of the steep cliffs by the action of the sea. None of those creeks or coves, in gales of wind, afford any shelter to boats. There are three boats belonging to Newtown Cove, and 12 boats to Lady Cove. All these small craft require to be drawn up on the land beyond the reach of the sea, such is the very unprotected state of the best-sheltered creeks to be found on any part of the shores of Tramore Bay, except the inner pool of Rhineshark.

The eastern side or shore of Tramore Bay is two miles long, reckoning from the strait or ferry at Rhineshark Pool to Brownstown Head, and the general bearing is S.W. by S. At low water this shore, along the Rhineshark entrance within the bar, consists of sand, and extends in length one mile two furlongs; and from the bar of Rhineshark to Brownstown Head is about three-quarters of a mile, and consists of a rocky exposed coast.

The harbour of Rhineshark has been formed and maintained by the scouring power of the water of the Back Strand. Within the strait, near the ferry, is a pool of from 2½ to 4 fathoms deep at low water, which is sheltered by the Burrow Strand from the prevailing gales and the run of the sea; and this is properly Rhineshark Harbour. There are five hookers and 24 small boats belonging to this harbour and the upper inlet. These hookers are about 12 tons each, and are employed in fishing. The 24 small boats are rated at three tons each, and are principally employed in carrying in manure and sand from the outer bar to the interior. This harbour is bar-mouthed, on which, at low water, there is not more than from three to four feet depth of water; the entrance channel is narrow and difficult to navigate, except by the pilot well acquainted with it, there being neither beacons nor buoys to mark the channel where it is navigable. The prevailing south-westerly winds blow directly into the entrance of this harbour, causing a dangerous run of sea, and making it extremely difficult to either small vessels or fishing craft of any kind to get out.

The bay of Tramore, in extent, may be taken at five square miles, and is completely open and exposed to all gales of wind blowing from south-east to south-west. The depths of water in it, commencing at its entrance, are 10, 8, 6½, 4, 3, and 1½ fathoms to within half a-mile of high-water mark on the front strand.

The Pollock Rock lies within half a mile of the head of the bay, and eastward of the middle of that part of the bay about half a mile. The bottom of Tramore Bay is in parts so foul and rocky that cables are frequently cut and ships lost. On Brownstown Head there are two towers, and on Newtown Head there are three towers; those towers are 60 feet high each and are whitewashed, and can be seen in clear weather a considerable distance seaward, to warn mariners of their approach to this dangerous bay. Lately the captain of the "Grecian," merchantman, from the West Indies bound to Liverpool, declared that he mistook Tramore Bay with the towers on its headlands for the entrance to Waterford Harbour; his ship consequently was carried in by the pilots to Rhineshark, from which harbour she was obliged to be towed out by a steamer, and taken round to Waterford.

The front strand of Tramore Bay, at the western end, is much less covered with sand than at the eastern; and the sand appears to be accumulating on the eastern side of Tramore Bay. The cause of this, in my opinion, is, that the run of the sea is much heavier from the westward than from the

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Tramore.

No. 61.

Bald, on the formation of a Harbour in Lady Cove.

eastward; this, added to the strong tide current setting into the back strand through the Rhineshark strait, carries all the loose moving sand towards the eastern side of the bay.

It appears, upon a careful examination of the west side of Tramore Bay, between Newtown Head and the town of Tramore, that the Lady Cove is the most eligible place to erect a small safety fishing harbour. The Lady Cove can be more safely approached and landed at by boats, when a heavy ground swell sets in, than at either the Fishing Cove or Newtown Cove. But it is to be observed that, when the swell is great, it is impossible to land on any part of this coast; and it is generally both dangerous and difficult to do so when there is anything like a run of high sea, because there are no works of defence erected upon any part of this shore to afford shelter or protection to boats to land during stormy weather; nor is there an artificial harbour of any kind on any part of Tramore Bay, comprehending an extent of 14 miles of coast. The Lady Cove is a small open bay, surrounded by high rocky cliffs and steep grassy banks. At low water it presents an area of 300 feet in width by 250 feet in depth, bounded at high-water line by a beach of shingle and stone, and the remainder of the surface is covered with rock down to low-water mark. In the centre the fishermen have cleared away a space of rock of 150 feet in length by 24 feet in breadth, extending from high to low-water line, for the accommodation of landing the boats, and which, for safety, they are obliged to draw up above high-water mark upon a road ending at the head of this little bay; and along the south side of the road runs a small stream, which falls into the sea within the proposed harbour.

At low water the Lady Cove presents an uncovered rocky beach for a breadth of from 140 to 200 feet, on which the sea has full room to expend itself, without rebounding back and producing those dangerous swells in gales which are always found to take place when the coast line of the water is terminated by a perpendicular cliff. Boats have, therefore, landed at low tide at the Lady Cove during heavy and dangerous ground swells, when they have found it impossible to do so at either the Fishing Cove or Newtown Cove, because these coves are narrow and bounded by high rocky cliffs, which the action of the waves against produces those high and broken seas which swamp and overwhelm boats and small craft in attempting to land at them.

I propose to construct a pier on the south-west side of the Lady Cove, as described, drawn, and delineated in the plans No. 1 and No. 2, which accompany this report. The pier is to run out in a direction S.E. by E. ¾ E. for a length of 140 feet, then N.E. by E. 85 feet, where it will terminate a little beyond ordinary low-water mark. This pier will protect the space inside intended for the harbour, because, by examination of the small chart of Tramore Bay, laid down in No. 2, it will be seen that the Lady Cove is opened to gales only blowing from between S.S.E. ½ E., and S.W. by S. ¾ W.; the first is the bearing from the Lady Cove to Brownstown Head, and the latter the general bearing of the coast lying to windward of it. The breakwater is to be at its base 90 feet broad, with a quay wall inside, rising eight feet above high-water spring; and the breakwater, seaward, is to be armed with a heavy pavement, set in a concave form, commencing at high water, and extending to the top of the stone parapet; then from high-water line to low-water line the sea pavement is to be of a convex form, as drawn and described in the transverse section delineated on the plan No. 1. The parapet is to be six feet high and six feet thick, and its windward side will form the upper terminating curved portion of the breakwater glacis, on which the run of the high sea will fall and play in stormy weather, blowing from between S.S.E. ½ E. and S.W. by S. ¾ W., being about 5¾ points of the compass, to which it will be exposed to the force and run of the ocean during storms and gales of wind. I am quite aware of the heavy and high run of the sea into this bay, and its destructive power; but I am also equally certain and convinced that it is practicable to construct a permanent pier that shall be able to resist the sea, and form an excellent safety harbour.

The sectional form I have given to the proposed breakwater nearly resembles the shape which Cherbourg Breakwater has assumed, after being many years exposed to the action of the waves, and encountering, during that period, repeated gales and severe storms. This is the form which nature in deep water will assign to such masses of heavy matter exposed to the roll of the sea; it is, therefore, the best shape to be adopted where marine works are to be constructed, which will have to encounter, during high gales and storms, the whole force of the open ocean.

It is proposed to cut out the whole of the rocky floor of the intended harbour, which lies between the pier and the small-boat channel cleared out by the fishermen; the rock taken out is to be packed into the interior filling of the breakwater; and the remainder of the filling may be taken from along the cliff, which extends from the root of the proposed pier to the end of the present road, terminating at the head of the bay. If the excavation be judiciously executed and kept above high-water line, a good roadway, 12 to 15 feet wide, may be made along this part, connecting the proposed pier with the present existing old road leading to the town of Tramore, which contains a population of 1600 persons, and is still rapidly increasing.

To connect the town of Tramore with the new proposed harbour by a new level line of road would be an useful and desirable work, because the old road is extremely hilly and much elevated. The distance from the proposed harbour to the town of Tramore, along the cliffs, is about three-quarters of a mile, and would form one of the finest road works yet executed in Ireland; while its usefulness would extend to all classes of society by its being level, and affording an easy draft to the drawing of loads of all kinds coming from and going to the harbour. This road would be useful in opening up many improvements connected with the rising town of Tramore, the Brighton of the south of Ireland.

I have, in plan No. 1, delineated a second arm or pier to the proposed safety harbour; but as the execution of this part would, when combined with the seaward pier, amount to a sum which could not perhaps be reasonably expected to be procured at present, I have refrained from putting the amount of its expense into the estimate, and more particularly because the experience of protection arising from the construction of the pier now recommended will become more fully known, and the further extension will proceed upon a more extended knowledge of the subject in all its details than can at present possibly exist.

During my second examination of the Lady Cove I had the kind assistance of Lieutenant Scudamore, of the water-guard service, who resides there, and who is thoroughly acquainted with the plan in all its maritime details and capabilities; and, as far as I consulted him, he coincided in opinion with me regarding the eligibility of Lady Cove, as being the best place for the erection of a small safety harbour, the practicability of its execution, and also the very great benefit there would be derived from it as a harbour for the extension of the fisheries on this portion of the coast of Ireland,

APPENDIX B.

TRAMORE.

No. 61.
Bald, on the formation of a Harbour in Lady Cove.

so extremely productive of all kind of fish. Within the bar, at ordinary high-water springs, there would be a depth of 11 feet of water.

In the event of a pier being constructed at Lady Cove, I do not apprehend that there will be any silting up, because the whole beach to seaward and windward consists of a clear rocky shore. There is also a stream of water continually running through the harbour, and which is considerable in winter, offering a scouring power of some magnitude under proper management, if such should at any time be required.

There can be no doubt that the erection of a pier for the protection of fishing-boats at the Lady Cove would extend the fisheries very much on this part of the coast of Ireland, because, as there would be safety and protection, boats of a larger size would then be procured. There lies immediately at Tramore Bay the best fishing-ground on the south coast, and where at present, when the weather permits, boats from Waterford and Dungarvan are constantly fishing. The Nymph Bank, which lies off this part of the coast, would open an inexhaustible mine of wealth to the fishermen of Tramore, who would be enabled to supply Waterford and all the interior towns with an abundance of fish.

I am so thoroughly convinced of the success which would attend the construction of this little safety harbour, that in place of 12 small boats (the number at present belonging to the Lady Cove) there would be hundreds; and I have no doubt there would be in a short period not less than 400 persons employed in fishing instead of 48, the present number. I am further convinced that this little harbour would give birth to a considerable import and export trade which does not at present exist, by which the trade and traffic of the country would be much increased.

In concluding, I cannot but express my regret that it has not fallen to my lot to advocate the erection of a larger harbour on this coast than the small one which I have now reported on. The disasters on this coast have been so numerous and so frightful, that I am impressed with the necessity, in a national point of view, of the erection of a large asylum harbour in deep water, near the entrance on the west side of Tramore Bay.

ESTIMATE to build a HARBOUR at the Lady Cove, Tramore Bay.

	£.	s.	d.
3333 cubic yards of rock, to be excavated out of the harbour and packed into the breakwater, at 3*s*. 6*d*. per cubic yard .	583	5	6
3333 cubic yards of rock, to be filled into the pier and breakwater, at 2*s*. 6*d*. per cubic yard	416	12	6
666 cubic yards of masonry in quay wall, at 12*s*. per cubic yard .	399	12	0
1894 cubic yards of masonry in covering and arming the breakwater, at 12*s*. per cubic yard	1,136	8	0
333 cubic yards of masonry in stone parapet, at 12*s*. per cubic yard	199	16	0
375 superficial yards of paving on top of quay, at 3*s*. per yard .	56	5	0
Stair and mooring posts	22	12	0
	2,814	11	0
Contingencies, 15 per cent.]	422	0	0
	£3,236	11	0

I am, &c.,

WILLIAM BALD, *C.E.*

Patrick William Power, Esq., and
George Lewis Smyth, Esq.

No. 62.

No. 62.
Owen, on a proposed Pier in Tramore Bay.

Report by J. OWEN, Esq., C.E., *on a proposed Pier in Tramore Bay, Waterford.*

SIR, 21*st August*, 1838.

In pursuance of the orders of the Board of Works, as communicated in your letter of the 20th May last, I had lately an opportunity of visiting Tramore Bay, for the purpose of inspecting the site for the proposed pier, and considering how far the project is likely to answer the object which the parties interested in the measure have in view, as described in the report of Mr. Bald.

It appears to me that the site selected is, under all circumstances, the best adapted for the purpose. This bay is truly described by Mr. Bald as being very much exposed, and affording no shelter to vessels that may be driven in by stress of weather, or be drawn within the vortex by the great indraft and run of the sea into the bay, and there can be no doubt, but the construction of a pier would prove an important convenience to the fishing craft in the neighbourhood, and operate as an encouragement and considerably improve the fisheries on this part of the coast. I fear, however, that Mr. Bald has largely overrated its utility in representing this work as likely to afford protection, as an asylum harbour, to the trading vessels of the country, or of giving birth to a considerable import and export trade: for these objects so small a work is perfectly inadequate, nor does it appear to me to be greatly required, with a port such as Waterford so near. The pier will, however, be extremely useful in affording shelter to the small fishing craft—an object of sufficient importance, as it appears to me, to justify its construction.

The plan proposed is in its general features very well adapted for the purpose; but as the main face is nearly at right angles with the prevailing winds and heaviest sea, I would recommend the form described by the plan No. 2, and also that the base of the pier be extended, so as to give a somewhat flatter slope than Mr. Bald has proposed. Estimated cost 4,247*l*. 18*s*. 6*d*.

I would also recommend, that the pier should be extended so far as low water mark of ordinary spring tides, as shown by plan No. 2. These alterations will probably add 1000*l*. to the estimated

No. 62.
Owen, on a proposed Pier in Tramore Bay.

cost, but this additional outlay will be fully justified in the increased stability of the work, and in the additional advantages it will afford.

The space within the pier is at present a bed of rocks, which it is proposed to be excavated in constructing the pier; when this is done the sand will very probably accumulate on the surface, and form a bed on which vessels can ground without injury.

As the project of a road along the margin of the harbour is only mentioned incidentally, it is not necessary to offer any observations thereon, except that the expense attending the execution of such a scheme renders the performance of it probably very remote. To the rising town of Tramore, such a pier as that proposed will be most useful, and in a more enlarged view the work appears to merit a favourable consideration.

J. OWEN.

Henry R. Paine, Esq.,
&c. &c.

No. 63.
Kellett, on the want of a small Harbour at Lady Cove.

No. 63.

Report by Captain KELLETT, R.N., *on the want of a small Harbour at Lady Cove, Tramore.*

SIR, *Tramore, 15th September,* 1845.

I beg to enclose a copy of the report of Mr. Bald, engineer, an estimate from the same, and a report from Mr. Owen, employed by the Board of Works, relative to the proposed pier at Tramore, and also a list of vessels wrecked or stranded in Tramore Bay, between the 24th day of November, 1835, and the 9th September, 1845. I have to call the attention of Her Majesty's Commissioners to the fact, that in a bay that has been more fatal to the lives and property of Her Majesty's subjects than any other, I believe, within the United Kingdom, it has hitherto been impossible to give the slightest assistance to any vessel in distress, nor even a position from which a life-boat could be launched. I am satisfied had there been a pier or shelter of any description, from which a boat could be launched, numbers of valuable lives would have been saved, even from the ill-fated "Seahorse" transport, when on the 30th January, 1816, hundreds perished without an effort or possibility of giving assistance; and during the last winter a vessel became a total wreck under my eye; no attempt could be made to assist her by boat, and one man was drowned. Between Rhineshark, with a bad bar, and Dungarvan there is no place where the numerous fishermen could find shelter, in the event of a sudden storm.

I am, &c.,
ARTHUR KELLETT, *Commander R.N.,*
Inspecting Commissioner.

Captain Washington, R.N.
&c. &c. &c.

No. 64.

LIST of Wrecks in Tramore Bay.

Date.	Name of Vessel.	Rig.	Tonnage.	Where from.	Where to.	Wind.	Cargo.	Remarks: Probable cause of going ashore.
Nov. 24, 1835	Cuba . . .	Brig. .	200	Alexandria	Liverpool .	S.S.E. to S.S.W.	Cotton. .	Crew and cargo saved, and got off at great expense.
Nov. 25, ,,	Two Sisters, (French).	Ketch .	50	Nica . .	Rouen . .	S.S.E. to S.S.W.	Oil, tallow, and fustic.	Total wreck, crew and cargo saved.
Mar. 19, 1838	Active . .	Brig. .	90	St. Ubes .	Liverpool .	S.W.	Cork . .	Got off again, crew and cargo saved.
Oct. 10, ,,	Swan. . .	,,	70	Cork . .	New Ross .	N.W.	Ballast. .	Got off again, crew saved. Great carelessness in getting on shore.
Oct. 23, ,,	Brothers . .	Schooner	70	Newport .	,,	S.S.W.	Coal . .	Crew and cargo saved.
Nov. 28, ,,	Speculateur, (French).	Brig. .	Not known	Liverpool, (supposed in ballast).	St. Malo .	Com. S.E. ended S.W.	Ballast. .	Had landed wheat in Liverpool. Crew all lost.
Mar. 13, 1839	Letitia . .	Sloop .	16	Swansea .	New Ross .	S.W.	Calm . .	Total wreck. Crew and part of cargo saved.
June 22, ,,	Prince Regent	Barque .	256	Newport .	New York .	S.W.	Railroad iron.	Total wreck. Crew, passengers, and cargo saved.
Jan. 11, 1845	Elizabeth. .	Brig. .	160	,,	Youghal .	S.W.	Coal . .	Total wreck. Four of crew and part of cargo saved. One lost.
Nov. 6, 1839	Unknown. .	Hooker .	20	Co. Cork .	Waterford .	S.W.	Potatoes .	Running for Rhineshark; did not know the entrance over the bar. Two lost.
,, ,,	,,	,,	15	Cork . .	,,	S.W.	Potatoes .	Run on shore, and got off again by throwing overboard the cargo.

No. 65.

CORK HARBOUR.

No. 65.
Evidence taken on the 10th Sept., 1845.

Examining Commissioner—Captain Washington, R.N. and F.R.S., assisted by Captain Frazer, of H.M.S. *Lucifer*, and Captain Wolfe, of H.M.S. *Tartarus*.

Present:—The Mayor of Cork; Daniel Callaghan, M.P.; Sir T. Deane; T. S. Reeves; Daniel Meagher; John Gould; John Carroll; F. B. Beamish; R. Honan; W. M. Drew; William Harrington; Thomas Hardy; Jas. Cleary; Hatton Galwey; Charles Sugrue; W. B. Hackett; H. K. Feath; Dr. Lyons; Danl. Donegan; George Laurence; J. M'Mullen; Capt. White; Joshua Hayes, Joshua Hargrave; B. Verling; John Hodder; T. G. French; Edmund Leahy, C.E.; F. Jennings; P. Greer; and Keeffe O'Keeffe, &c.

[*The Admiralty Survey of Cork Harbour by Captain Wolfe, R.N., was laid on the Table.*]

The Commissioner called upon the Secretary for the Acts of Parliament under which the Harbour was governed, and inquired into the constitution of the Board.

The Mayor said the Board was elected by the Town Council, four members going out annually by rotation—and the Mayor, Sheriff, and the City Representatives were members *ex officio*, in all 35.

The Secretary.—It is not necessary that the members should be ship-owners or sailors; there are many ship-owners on the Board, but no sailors.

A list of the Commissioners, with their professions attached, was handed in.

Joseph Francis Spearing examined.—Is Sub-Treasurer to the Harbour Commissioners. The accounts were duly audited by individuals deputed by the Corporation. A Harbour Commissioner could not audit the accounts. The returns transmitted to the Secretary of State were accurate. There is still a debt due by the Harbour Board of about 11,000*l.* It was 12,875*l.* in 1844; and has been reduced since about 1,400*l.* or 1,500*l.*

Mr. Hayes said it would not be amiss if it were told how the debt accrued. That under the Act of Parliament, the Commissioners had no power to borrow at all.

Mr. Callaghan said, the auditors never looked to the legality of the payment, but merely to the clerical accuracy of the accounts. I should say that the auditors have not acted as auditors usually do in the performance of their duty. In casting my eye over the books, I perceive an item of 25*l.* contributed by the Commissioners towards a public railway, which I think wrong.

Mr. Gould.—On that subject I may be permitted to say that the Harbour Commissioners acted according to the best of their judgment, with a view to the productiveness of their revenue. They conceived that in giving that contribution towards the preliminary measures connected with the Great Southern and Western Extension Railway, they would be furthering a project that would undoubtedly have the effect of increasing the trade of Cork, and consequently of increasing the revenues of the port. That is the explanation I have to give of that item.

Mr. Hayes said, there was an item in the account of a payment made to an officer of the Board of Works for coming down to Cork for the Harbour Commissioners, to sketch a line of a park, to be constructed with the public money.

Mr. Meagher said, that the gentleman alluded to by Mr. Hayes came down at the request of the Board of Works, and not for any purpose connected with the park.

Commissioner.—I cannot conceive it possible that the Board of Works would compromise their public duties by receiving payment for any private work.

Mr. Hayes said he derived his information from the public press. The fact of the officer of the Board of Works coming down here was known to the public, as well as the fact of his visit being partly made the means of facilitating an expenditure inconvenient to the trading interests; for the future industry of the public was mortgaged to an extent of 25,000*l.*

Sir Thomas Deane said, that from the character of Sir John Burgoyne it was impossible that anything improper should have occurred, so far as the Board of Works was concerned. The Board had immediate connection with various parts of the country, and it was an invariable rule that when an engineer was called upon, that his expenses should be paid.

Mr. Laurence said, that the information which the Harbour Commissioners required from the officer had reference to the advantage of certain alterations to the navigation of the river. It was contemplated at that time that the park should contain docks on rather a large scale.

Mr. Hayes.—I have simply alluded to a misapplication of the public funds, involving a sum of 25,000*l.* The debt, which is part of the inquiry, constitutes a portion of it. The Act of Parliament gives no power to borrow any money whatever. When Mr. Owen came to Cork under the pretence of doing public works—I do not mean the slightest disrespect to Sir John Burgoyne or the Board of Works, for they merely did their duty in sending down an officer upon the statement made to them—but I do say when that officer came down he knew nothing of the power under which the Commissioners made the application; and they showed to him the line of the river, having in contemplation a large expenditure and the making of a tidal way for the construction of works, which probably the Commissioners will visit before they leave this city. The industry of the citizens has been mortgaged to carry on these works, and that is the complaint I make.

Mr. Gould said, the question was not whether the 120*l.* paid to Mr. Owen for his expenses was a judicious expenditure, or whether the work was serviceable or not to the river—but whether it was a legal payment or not. At the time in question a great public work was projected—no less than a line of railway by the river; and it became the imperative duty of the Board to get the best advice as to how far the navigation of the river could be protected.

Mr. Meagher said, the Navigation Wall was projected by the Irish Parliament in 1763. The following record was in Edwards' Cork Remembrancer:—"1763—May 9th—The workmen began to clear the channel of the harbour of Cork, in order to build the New Wall; and on Monday the 30th, several hundred labourers paraded the city with spades and shovels on their shoulders, quitted their work on the New Wall, and turned out for 8*d.* per day, being then allowed but 6*d.*"

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CORK.
No. 65.
Evidence taken on the 10th Sept. 1845.

The amount contracted for by the Harbour Commissioners to carry on the wall was 18,000*l.*, and the 11,000*l.* now due was part of that debt. The Commissioners by so doing greatly improved the river, and protected the mercantile interests, as their freights and insurance were lowered. The wall did not trench upon any navigable part of the river.

Mr. CALLAGHAN said that he had met another illegal item, "Backing the Navigation Wall with mud." Though he was one of the oldest of the Harbour Commissioners he did not hold himself responsible for all their bad acts.

Sir T. DEANE said it might be material to mention that in building the Navigation Wall they had the sanction of the Admiralty.

Mr. GOULD.—The Harbour Board has agreed to a reduction of 25 per cent on the tonnage dues, export, and import dues, a few weeks ago. The reduction which was to come into operation from the 1st of October, would reduce the revenues of the Board by about 1,900*l.*

Sir T. DEANE.—And there is £11,000 due.

Mr. GOULD.—That was provided for by the estimate upon which the reduction was made.

Mr. THOMAS DEAVES thought it right to apprise the Tidal Commissioners that no person was allowed on the Harbour Board who was not a Repealer.

Mr. DONEGAN—That is the fact—the Corporation, who have the election of the entire Board, wil not elect any other.

COMMISSIONER.—Is the present mode of election considered just and fair? (Loud cries of "No, no.")

Mr. DONEGAN.—The ship-owners are here to complain of it. At the late election for Harbour Commissioners, one of the largest ship-owners of the port, Mr. Reuben Deeves, and two other gentlemen, were put off the Board because they did not advocate the agitation for the Repeal of the Union. We apprehend as ship-owners that before two years elapse, that interest will be without any representation whatever; and we submit that there should be some qualification, entitling a man to serve on the Board, besides the advocating of one side of politics or the other. We have the statement of the returning power that they will dispossess every man of his seat at the Board who is not a Repealer.

The MAYOR.—As chief magistrate, I beg to say that the "returning power" said no such thing. There has been no act of the Council making any settlement upon political grounds; and if there had it would be illegal.

Mr. MEAGHER said that it was not upon political grounds that Mr. Deaves had been thrown out, but because he had been a badly attending member.

COMMISSIONER.—My orders are, as I observed, to hold an impartial inquiry; and if the subject of Repeal is introduced here again, without connecting it with any substantial injury to the Harbour Board, I shall close this commission and leave Cork.

Mr. LAURENCE said there could be no doubt that persons on that Board, who had little interest in its management, were substituted for shipowners, whose interests would be promoted or impeded by a fair and proper system of representation.

HENRY HARDY, Esq., Secretary to the Harbour Board was then sworn and examined.—The present harbour debt commenced in May, 1832, when the debt amounted to only £233. The Act gives no authority to borrow money. The contractor found the money and got occasional payments from the Board.

COMMISSIONER.—I should be glad to have an account of the amount of the debt each year.

The TREASURER said he would prepare a statement for the Commissioners, giving the amount of the debt on the 1st November of each year.

Mr. WM. PRESTON WHITE examined.—I am Harbour-master for 25 years, and reside in the city of Cork. In my opinion there has not been any harbour in Her Majesty's dominions so greatly improved as this harbour. When I first became connected with the port as Harbour-master, a ship of 140 tons could not come to the quay without leaving half her cargo at Blackrock; while now a ship of 500 or 600 tons can come up to the quay. The river has been deepened six feet from the flats, and we are now deepening it more. Vessels are now able to leave Passage early and come up to Cork in one tide, whereas formerly it took them two or three. The dredges are one 16-horse power, and the other 12-horse power. About 5,000 tons of soil they dredge a-week. It is deposited at the back of the Navigation Wall, above high-water mark upon the wall. A great part of it is used for ballast, and the gravel is sold for 1*s.* a ton. The soil now being dredged, being mud mixed with a little sand, is not fit for ballast. There is a bar in the river which has been lowered six or seven feet. The mud coming down the river causes the Flats, which lie about one mile above Passage. There is a depth of about seven feet at low water alongside the quays. There is a deposit of mud along the quays, and we kept the dredges constantly at work to remove it. In consequence of the number of angles in the river, the deposits are very considerable. Have not had the means to take any steps to cut off these angles. The trade of the port has much improved in consequence of the dredging. There can be no doubt that a further sum of money laid out for the purposes of dredging, and to cut off the angles, would improve the port much. It is left entirely to me to point out where to dredge. We are not limited as to the amount of work to be done, but our power is not so great as I could have wished it. I have had occasion to make complaints to the Harbour Commissioners of obstructions desirable to be removed, which have been attended to as far as their means would permit. No doubt but that a reduction of 25 per cent. in the dues will further cripple their means. I think there is a necessity for a further power of dredging. If we had two or three more dredging-vessels we should not have one too many. No harbour is so capable of improvement as this harbour. Certainly dredging is the best means of improving a port. No steps have been taken to direct the current by building walls; but we have taken every means to straighten the channel.

Mr. HAYES.—Will you be good enough to ask the witness whether the dredges have not been frequently suspended in their work?

WITNESS.—The dredges do not work the year round, and we do not dredge up rocks or stones, nor do we allow ballast to be thrown overboard; there is a penalty of 20*l.* for so doing. The dredging-machines are efficient for the size of them, but we require more. One was built at Shoreham, and the other was had from the Government. We can dredge in 22 feet water, at high water. If we deepened the river more our ladder would require to be longer. We have not had barges enough till lately. In fact we could do a great deal more if we had more barges. We have now fourteen. The expense of lifting and depositing the stuff does not cost 5*d*. a ton in deep cutting. There is a great quantity of gravel comes down the river in the course of the winter. Before we got the dredge-vessels I knew 400 tons to be brought down in one fresh. The tide goes up about a mile and a half above the city. A weir, which turns the tide down, a part to the north and part to the south, stops it there. There are other weirs there. No doubt they are one of the great causes of the deposit in the harbour. They were erected I suppose some centuries ago. They belong to different individuals.

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No. 64.

Evidence taken on the 10th Sept. 1845.

The **MAYOR**.—The principal weir belongs to the Pipe Water Company.

WITNESS.—If this weir was removed higher up, the tidal waters would flow perhaps about a quarter of a mile. There is a fall there, and it would not flow much above the weir. One small weir was erected about ten years ago. There is a weir below this I have spoken of, about half a mile above Cork. The tide flows through it. There are flood-gates, and the stream comes through the flood-gates.

COMMISSIONER.—Do not these weirs contribute very much to prevent the scouring of the harbour, and thereby to cause deposits?—I think so. The last weir I spoke of was built with the consent of the Harbour Commissioners. It is the first of the flood and the last of the ebb that is the scouring power in the river.

The **MAYOR** said there were seven weirs on the river of Cork, within a mile and a half of the city, and several obstructions from the quays down, which they were removing by degrees.

[Captain Wolfe referred to the chart, and pointed out the tortuous channel of the river, which in addition to the weirs had the effect of impeding the channel. The Board had not got a copy of Captain Wolfe's survey, but would apply for it, as it was a most valuable document.]

F. Until the recent survey by Captain Wolfe, they were not aware of the extent of the Harbour rock, which extended 185 feet one way, and 125 the other, since which it has been sufficiently buoyed. The harbour light might be improved. It is an oil light. The reflectors should be better, and the redness in the light should not be so great. I think it should be a lighter colour to distinguish it from the Kinsale light. Have heard complaints of the want of coast lights. The trade wish that a light should be placed on Cable Island, near the entrance of the harbour, and that would answer for a light for Youghal as well as Cork. The nearest coast-light to Cork is Kinsale to the west and Waterford to the east, a distance of 60 or 70 miles without any light. The Harbour Commissioners have written to Government on the subject

Mr. **CALLAGHAN**.—There was no refusal on the part of the Government, though nothing was done in the matter. The doubt seemed to be, whether Cable Island or Ballycotton should be fixed upon. The reason of the delay seemed to be, that Government had not a proper control over the Ballast Board in Dublin; but a communication was made to him that now would be the time to apply.

Mr. **LAURENCE**.—It is necessary that a light should be placed either on Cable Island or some place in that neighbourhood.

Mr. **WHITE**.—I am well acquainted with the coast lights. The Cork light is not efficient. The Waterford and Kinsale are beautiful lights.

Capt. **FRAZER**, R.N.—If there were a light on Cable Island, there would be no mistaking the Cork harbour light.

Mr. **LAURENCE**.—The elevation of the Cork light, or the alteration of its position, would make it much more efficient. Have heard complaints about the colour of the light-houses, and I have experienced a difficulty myself in distinguishing the light-house at all in a fog. I have come to Cork in a very thick fog by the lead; I have not been able to see the light-house in a fog till I came close to it. The light-house is the more conspicuous for being white. The quays were built by Sir T. Deane, under my inspection. The foundations are not sufficiently deep to admit of dredging; they were laid some years before I was appointed harbour master, and are only seventeen feet from the foundation to the top. The line of the quays is not the best that might have been chosen for the benefit of the port. The harbour debt was incurred in building the new wall. I rather think it was not an engineer that laid down the lines for the quays or the wall, but I was not admitted into the Board upon the occasion. There is no engineer connected with the Board, but there is an architect. I should mention that Mr. Vignoles was then down here, but his object was to lay out a railroad. The wall was not built to direct the current, and certainly has not fulfilled that intention. The deposit is owing, in a great measure, to the imperfect direction of the wall and the quays.

HARBOUR-MASTER.—The real object of the wall, I believe, was for a railway.

Mr. **MEAGHER**.—The wall was commenced before there was any idea of a railway. It was undertaken to carry out the intention of the Irish Parliament, to have it continued to the King's Quay, at Black Rock. The Harbour Board did contemplate that it should be taken down to the King's Quay, but their funds fell short, and they carried it only half way. There was no railway spoken of at the time.

Mr. **M'MULLEN** never heard it before insinuated that the wall was made for the purpose of a railway; but it was intended to improve the navigation, and to enable colliers and other ships to be tracked, which had stopped in their passage.

Sir T. **DEANE** said that Mr. Nimmo was consulted; for the work that was contemplated included docks, and the general improvement of the river. If any error arose as to the direction of the currents, it was because they had not funds to carry on the wall. Mr. Killaly, another engineer, was also consulted. The railroad speculation was entertained, because it was considered that it would tend to the general improvement of the city.

Mr. **HAYES** begged to hand in a document to the Commissioners. It was dated Dec., 1836, and was a remonstrance from the ship trade of Cork against the construction of this wall; and though the Commissioner was told that the wall had no connection with the railroad, that document adverted in distinct terms to its being intended for a railway. (See p. 121.)

Mr. **GOULD** said that a considerable number of individuals who signed that document, did so on the ground of the expense of the work, and not on the ground of its inutility.

The **HARBOUR-MASTER** continued to observe that this river might be dredged so as that a 74-gun ship might come up to the quay. One dredge cost 1,250*l*., and the other 1,750*l*. Rubbish from the Glanmire road is not thrown in now, as the parties who had done so were summoned. There is a permanent tide-scale at the Custom-house.

Mr. J. **Jennings** said that the tide-guage was made by Mr. Woods, of Port Glasgow, and was found to answer very well, though as yet it was worked only experimentally.

Harbour-master.—We know when the tide rises and falls, but there has not been a regular registry hitherto.

Mr. **Hayes**.—This map, with Mr. Owen's name to the plan of the new wall, has been shown to you to illustrate the extent of the mischief done by the Harbour Board: the plan has not been carried out from the want of funds.

Harbour-master.—I object, in this plan, to a curve instead of a straight line; besides, I should have built a wall on the north side of the river.

Mr. **Meagher.**—The best thing to be done now, is to continue the line along.

Mr. **Hayes** suggested that Captain White should be asked whether the exclusion of the tidal waters for the purposes of the park, had any effect on the navigation. The ground converted to the park was recovered from the river, nearly all of it. The works did exclude the water to a certain extent. My opinion is that the wall should have come down in a straight line.

Capt. **Wolfe** suggested that the angles should be cut off, and a gentle curve preserved. It is a question, now that you have enclosed that slob, whether it belongs to the corporation or the Government. I have very little doubt that it is the property of the Government.

The **Mayor** recollected that as far back as forty years ago, vegetable matter and marsh plants grew there in great quantity.

Commissioner.—The Glanmire river might be deepened with advantage, its line improved, and its eastern channel recovered?—Yes; it is at present a very shallow and crooked channel.

The **Mayor** said there were projections by landed proprietors there into the river.

Capt. **Wolfe** said the Glanmire quay was a very indifferent one. It was in a shockingly neglected state.

Mr. **Callaghan** said that the landed proprietors, from whom the grand jury was selected, neglected to do anything.

The **Harbour-master.**—It would be an improvement to deepen the Douglas Channel, but we cannot spare our dredging-vessels at present. It would be an advantage to have the part of the river below the Custom-house, converted into a floating-dock. He would also cut a channel right through the slob. As to making a floating-basin of the south channel, it would be attended with difficulty, in consequence of the number of sewers which went from one river to the other.

Sir T. **Deane** observed that through the exertions of the Harbour Board, the water was much deeper in the river than formerly. There never was a Board that did more service with such limited funds.

Mr. **Jennings** directed the attention of the Commissioners to the practice of reclaiming land along the river, and obstructing the waterway.

The **Mayor** said the corporation believed they could never meddle with marshes, their power being confined to the navigable part of the river.

Harbour-master.—Before the quays were built, the river used to be frequently flooded; but in consequence of the late improvements, he had not noticed a flood of any importance. Boats used ere now to float in the streets at the north side of the river. Had not heard of complaints having been made of the state of the port; but if any captain mentioned to him that there was a deposit of stuff in any particular spot, he immediately sent the dredging-vessel to have it removed. The Midlaton Railway Company waited on the Harbour Commisioners to allow them to come into the city on the north side of the river; but they would cut off at the south side as much as they would entrench on the north, thereby giving a straighter direction to the navigation, which would be a great improvement.

Dr. **Lyons** made a statement to the effect that the railway company alluded to intended to take as much space off the navigation wall as there would be occupied in the erection of the wall at the north side. If they would follow that line, such as is pointed out as far as Blackrock Castle, it would give the river a straightened direction, which would be very valuable.

Mr. **Hackett** said it was the intention to construct a swivel bridge there across the Glanmire river; as to the present bridge there was no occasion for it or a similar one, unless the navigation was improved by the Commissioners. The present bridge was not raised once in six months.

Mr. **Keeffe O'Keeffe** examined.—Owing to the soil along the banks of the Lee, quantities of sand and slate were brought down by the winter floods, which formed a deposit in the harbour. This deposit required crowbars and considerable power to remove it; in fact it could not be removed by shovels. As to the Sunday's Well Weir, or, as it was termed, the Pipe Water Weir, he conceived that to be the cause of all the expense attendant on the dredge-boats, and the reason why the harbour was choked. In the year 1760, for the purpose of making the Lee navigable to Macroom, a gentleman named Fitton got permission to build a weir across the Lee 18 inches in height. That was now termed the Pipe Water Weir. In 1791, Mr. Attiwell Hayes, who was proprietor of the North Fishery, had that weir raised from 18 inches to 6 feet, which was the great barrier to the clearing of the harbour. He heard there was an Act of Parliament obtained, but was not certain. In 1810, Mr. Thomas Walker, the proprietor of the St. Dominick's Mill, now in his (Mr. O'K.'s) family, brought an action against the Pipe Water Company, and established his right, and got the weir lowered and two hatches in it. Last year the Pipe Water Company got notice of that fact, which indeed was matter of public record, and yet for their own purposes they raised the weir again, and thus checked the velocity of the river. The direct course of the Lee was the South Channel, though at present it had scarcely any water at all. Mr. A Hayes, the present proprietor of the fishery, was now putting hatches at Gill Abbey.

Mr. A. **Hayes** said he was the gentleman alluded to, and he certainly was putting up hatches which Mr. O'Keeffe had pulled down.

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No. 65.

Evidence taken on the 10th Sept. 1845.

Mr. O'Keeffe said his mill was not able to turn that week for want of water, and in fact a person could walk along the bed of the South Channel, as on a strand. Allusion was made by Mr. Besnard to the Pipe Water Company, but an adverse verdict did not always show the merits of a case, and he (Mr. O'Keeffe) was advised by eminent counsel that that verdict would be set aside, and it would be set aside next term—it was monstrous—against evidence and law. There are several other weirs in the South Channel. There was a bald weir near Gill Abbey, for the purpose of maintaining water for the mill lower down.

Mr. Perrier wished to ask Mr. O'Keeffe, if he had not, within the last few months, raised that bald weir, and staunched the back of it.

Mr. O'Keeffe said he did not raise it, but he staunched it, as well as a gravel weir could be. Some midnight persons came with crowbars, when they saw a prospect of a flood, and made an opening in the weir, so that the water then carried away 40 feet of it. In a water-way, where there was a gravel foundation, allowance was made for sinkage, and making that allowance in the present case, he would say he had not raised that part of the weir above the level of the rest, and after the winter it probably would be lower.

Mr. Julius C. Besnard stated that he was law agent to the Pipe Water Company. The weir was not erected by Act of Parliament, but they took water from it by Act of Parliament. The present weir, which they would call No. I, was put there instead of an old weir which was carried away by the floods. It was repaired within the last year; did not immediately know to what height above the river, but the question decided by the jury was that it was, not raised above the old level. The Pipe Water Company had not specially any Act authorising them to raise that weir above the height they originally found it. As to the public record alluded to by Mr. O'Keeffe, he never heard of it; he could not imagine that weir was prejudicial to the navigation of the river, for the water went over it. If the water were drawn from higher up the river, the company should build new works.

Mr. O'Keeffe.—Some months ago, in dry weather, there were eight inches of water going over the weir; and that day it was reduced to one inch and a quarter. He found in the *Cork Remembrancer*, under date April, 1810, the following:—

"An action, brought by Thomas Walker against William Lumley, the representative of the Pipe Water Company, was tried by Judge Day, in this city, for raising the weir near the Pipe Water Works to a certain height, and for shutting up two hatchways, thereby diverting the water which ought to flow through the Southern, into the Northern Channel. The facts of this case, as they appeared in evidence, were—In the year 1765, the weir was built by Nicholas Fitton, to assist a project which was then on foot for making the river Lee navigable to Macroom; but he was only suffered to make the weir 18 inches high, and was compelled to put two hatches in it of sufficient breadth to let the water flow in abundance into the Southern Channel. In the year 1785 the weir was in some degree raised by an engineer to the Pipe Water Company, but not to a height sufficient to exclude the water from the Southern Channel, until, in the summer of 1791, Mr. Attiwell Hayes, who was one of the Pipe Water Company, raised it to the height of about six feet, and blocked up the hatches. The jury found a verdict for the plaintiff, with 6*d*. damages and 6*d*. costs."

Mr. Besnard said an immense flood carried away 40 feet of weir, which was never completely repaired, and which was the place over which the water alluded to by Mr. O'Keeffe was seen to flow.

Mr. O'Keeffe said there was a breach some years ago, but a quantity of stones had been placed there higher than the original weir; that breach was 40 feet, but the entire weir was 303 feet across the river Lee.

Mr. Redmond O'Driscoll wished to direct the attention of the Commissioners to the weir built within the last nine years, across the river from north to south, and not far from where he resided. It amounted actually to a stone pier, and though there was a water-gate in it, it was passed with great difficulty. Several poor men who earned a livelihood by drawing sand to the city, were forced to discontinue their labour in consequence of the erection of that weir. The weir was built at the joint expense of Messrs. Wise and Beamish and Crawford—the former of whom had a distillery at one side of the weir, and the latter firm a mill and brewery at the other. They had no authority for erecting that weir. There was a weir there before the present one was erected, but it was formed of a species of wicker work, and did not go quarter across the river. In consequence of that stone weir, there was often a depth of water very near his place, in fact within six feet of it, of fourteen feet. There was a stone fence also erected in front of Mr. Hayes's weir, which prevented the tide coming up, and hindered persons who formerly earned a comfortable livelihood by drawing sand, from passing up the river, except once in 24 hours, and that not always.

The **Mayor** said he had been requested to put a question before the Commissioners, as to the title of the corporation to the Slob, or any other ground which they might reclaim.

Commissioner.—By the Act 46 Geo. III., cap. 153, entitled an "Act for the preservation of the public harbours of the United Kingdom," no pier, quay, or embankment shall be erected near to any public harbour, or even so far as the tide flows, without giving one month's notice to the Secretary of the Admiralty, under a penalty of 200*l*. In my opinion, there cannot be a doubt but that all such land between high and low water mark belongs to the Crown. With respect to the Thames, he was afraid even the Admiralty Solicitor could not give any definite answer to a question of title to such land, for the very matter was now pending between the Woods and Forests and the City of London, as to the right of soil on the river.

The **Mayor** said the corporation only wanted it for a park to afford the citizens air and exercise. They did not want to convert it into a source of profit.

The **Commissioner** said the Ministers of the Crown, he was sure, would be disposed to give to the people of Ireland everything they possibly could.

Mr. Callaghan, M.P.—In the present instance the Commissioners were surrounded by gentlemen who would tell them many things, but the truth was, that the corporation never went straightforward to work in this matter. They never showed a title to the ground called the Park, though they were asked to do it. He would state it openly, what he mentioned before, that if there was an investigation into the facts of the case, he did not think they would bear the light. He wished the corporation to do whatever they deemed conducive to the public benefit, and he begged of them to apply for an Act of Parliament, in order that they might proceed with security. A law agent had been indeed employed to draw up a case, but it was two years after the reclamation of the slob had been com-

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Evidence taken on the 10th Sept. 1845.

menced that that case was perfected, and the opinion had upon it was never given to the public. The corporation usurped that property, and they did injury to the harbour, against the repeated remonstrances of those who had no object in view but the public interests.

Mr. **EDMUND LEAHY** (County Surveyor), examined.—He stated that as he was a pupil of Mr. Nimmo, whose name had been mentioned, he would wish to refer to the circumstance by which it was introduced. Mr. Nimmo did not encourage the idea carried out in the inclosing of the Park, his opinion being that that inclosure should be a receptacle for the tide, and from which a powerful scourer to the river could be made available. He entirely concurred in the opinion of Mr. Nimmo. He had no doubt that a depth of 12 feet could be maintained at low water from this to Passage, by availing of the scouring power of the tidal water, and also the inland flow. He was also of opinion that the removal of the weirs would be of advantage to the river, for the natural current would then obtain a deeper and more rapid flow. The area of the upper harbour from Black Rock Castle was an extent of 760 acres at high water; 156 acres were inclosed by the embankment lately made, over which the tide used formerly to flow at an average depth of three feet three inches, thus giving an available quantity of water at every tide of half a million of tons, which would act as a scouring agent. He maintained that if they united the natural scouring power of the tidal water, with the removal of the weirs, a depth of 12 feet of water could be maintained from Cork to Passage. The greatest possible room should be made for the tide water. He then alluded to improvements going on in the River Clyde, and also in Glasgow, and stated that captains of vessels from the latter place informed him that vessels of some thousand tons could get up where those of 100 tons could not float before.

Mr. **CRAIG** said the injury done the Cork Harbour, was not by taking in the slob; but by leaving it open at one end, causing a solution of mud to be deposited in the way of vessels at the ebb of the tide. If the slob were entirely inclosed, it would improve the navigation.

Mr. **LEAHY** said, mention having been made of the North Bridge, he wished to say that the foundations of that bridge were bad, and if the pavement in the bed of the river were removed, it would be likely to be injurious to the bridge itself.

Capt. **WOLFE** observed, that when water was diffused, as in our river, it had no effect as a scouring agent.

Mr. **LEAHY** said the embankment at the lower end should be closed, and the water allowed to flow in at the upper end, and then on the recession of the tide it would form a powerful scourer. By that means, the deposit in the bed of the river would be avoided. The navigation wall as at present was productive of much injury.

Sir T. **DEANE** said, if the work was finished, the obstructions complained of would be removed.

Mr. **LEAHY** said, the present injury was owing to the unfinished state of the wall.

Sir T. **DEANE** observed, that the Harbour of Cork was the victim of half measures. If the original suggestions were carried out, much good would be the result, but it was for the want of funds they were obliged to stop short.

Mr. **CALLAGHAN** said, it was not for want of funds, but having consulted engineers, they afterwards altered their course at the suggestions of private individuals.

Sir T. **DEANE** said, with great respect, they had done no such thing, they had followed Mr. Killaly's plan.

COMMISSIONER.—Was there any doubt that, by deepening the pavement under North-gate Bridge and removing the weirs, a great scouring power could be obtained?

Mr. **LEAHY** said, he was convinced there would. He would here state another fact, that nearly one third of the whole harbour had been taken in from time to time. A large area, 170 acres, over which the tidal water used to flow, was enclosed along by Belvelly Bridge. There was another great space belonging to Mr. Bury.

The **MAYOR** observed, that there were a few gentlemen now taking in the Douglas river, near Bessborough.

Mr. **LEAHY** said, the encroachments there would be very injurious. The Glanmire river would also be very useful, if properly cleared; there was a very important traffic in sand carried on in that country, and vessels of 100 tons used to sail up there. Some vessels had falling masts, to allow them to get under the present bridge, but a swivel bridge was in course of erection, which would allow vessels with standing rigging to get in.

Mr. **HACKETT** said, he had never seen a vessel of the tonnage mentioned by Mr. Leahy up the Glanmire river.

Mr. **LEAHY** said, they certainly were very few.

COMMISSIONER.—Vessels of 100 tons are as much entitled to the use of the Queen's highway as those of 1,000.

Mr. **LEAHY** said, there was no doubt that all tributary streams were very important. The Carrigaline river could, at a small expense, be made of great service to that district.

Mr. **BALLARD** complained of the state of that channel, adding, that they were obliged to clear it at their own expense, without getting aid from the Harbour Board.

Mr. T. **COPPINGER** said, the Ballinacurra river had contributed on an average 1,000*l.* a-year to the Harbour Commissioners; and with the exception of a quay, they never had a shilling of that money expended in improving the place. If a few embankments were now removed, vessels of 70 and 80 tons additional would be able to get up that river.

Mr. **LEAHY.**—There are timber weirs on the Bandon river which are very injurious. If they were removed, and the river dredged and buoyed, it would be very important. The Douglas river might, at a small expense, be made valuable to the country.

Mr. **HARDY**, examined.—There are 140 pilots; they are appointed by the Harbour Board, after examination by the Harbour-master, and on the recommendation of the merchants or ship-owners.

Mr. **MEAGHER** said, the Board refused to allow the owners of ships to make their captains pilots; and any man taking charge of a vessel, who was not sanctioned by the Board, would be liable to a prosecution.

APPENDIX E

CORK.

Evidence taken on the 10th Sept. 1845.

HARBOUR-MASTER.—They had no power to compel pilots to go out to look forships. They had no such establishment as they had in Waterford where the pilots were forced to go out in a regular cutter. He thought it most essential that there should be a pilot-cutter here. In the event of a Harbour Act, he wished that the dues should be assimilated, and practical men placed on the Board, such as ship-owners and masters.

Mr. CALLAGHAN said, with reference to the funds of the Harbour Board, he wished to say a word; in the year '20 they got an Act giving revenue and tonnage dues. They had the first year 7,000*l.* revenue, and so on, until the year '26, when they made their first expenditure for clearing the river. They had that income for seven years, without applying any of it to deepening the channel.

Sir T. DEANE said, before the dredging-machine was taken in 1826, the Board had entered into a contract with Mr. Price to deepen and clear the river. In fact, that was one of their first acts. Sir Thomas could not sit down without alluding to a subject already before them, namely, the conversion of the south channel into a floating basin. From the Custom-house to Parliament Bridge could be easily made into a floating dock. The only difficulty would be the sewers, which could be directed into the archways.

The MAYOR thought the duty should be *ad valorem*, not arbitrary as at present. If there was a new Act of Parliament, the dues should be revised, for the whole system was bad and confused.

Sir THOMAS DEANE said, 100,000*l.* were expended on the new quays round the city.

Mr. J. COTTER said, he might call himself the oldest merchant in Cork, and he might say a word. The whole mischief was done by deviating from the original docket drawn up by disinterested men who were all paying dues at the time. Gentlemen, however, cut down those dues without making any compensating taxation, and they accordingly got into debt and now wanted help. He said the port of Cork was not taxed out of proportion, or as much as it required. To remain in debt was no way to improve or keep up a port, and when gentlemen found the harbour well improved, it was then time to think of reduction. Taxation did no injury at Glasgow.

No. 66.

Nimmo, on Improving the River and Harbour.

No. 66.

Report on the Means of Improving the River and Harbour of Cork, with various Suggestions for Improvements in the River, for Wet Docks; with Estimates.

By ALEXANDER NIMMO, *Civil Engineer.*

Cork, 11th Sept., 1815.

Introduction.—The city of Cork was originally founded on some marshy islands, embosomed by the river Lee, where it enters the tide-way. It has gradually extended down the river, and over the rising grounds on either side. With the extension of the buildings, most of the docks or creeks have been arched in or filled up, thereby forming, as in Antwerp, some of the finest streets in the city.

The river is now confined to two branches, on each of which quay walls have been constructed as far as the junction of the channels, where a handsome custom-house is now building. These quays are mostly imperfect masses of rubble-stone, rising only from low water, and obstructed at the foot by banks of mud and rubbish, which dry during the ebb.

The lower harbour of Cork is large and good. It admits ships of any size. The men-of-war lie below Cove, in five to eight fathoms water, and ride safe in all weathers. Merchant ships lie off Cove, or ascend the harbour to Passage, which is five miles below Cork. Vessels that draw ten or eleven feet water only can go up to the city with spring tides; with neaps they can go no higher than the King's Quay, about two miles, or in the channel, about one mile, below the city.

This great defect of Cork, as a sea-port, may have been less felt in former times, when it is probable that the river was deeper, and the draught of merchantmen frequenting it less than at present. Independent of the natural tendency of all rivers to protrude their banks and raise their channels, the Lee, forming the common sewer of a great city, must necessarily have been the receptable of an immense quantity of soil; much has been carried down into the harbour, and the banks and shoals have warped up within memory.

In 1761, upon petition from the city, an aid of 4,000*l.* was granted by the Parliament of Ireland, for removing the shoals between the city and Black Rock; and, with this view, an embankment and quay of stone, called the New-wall, was begun along the south side of the united channel. It extends for fifteen hundred yards below the Custom-house, and was originally intended to have been carried further, but has been discontinued for want of funds.*

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* The description of the shoals at that time (there is no plan) does not entirely agree with their present state; and there can be no doubt but this wall, in so far as it tended to confine the flood waters of the Lee, and keep the whole in one bed, may have deepened, or at least preserved, the channel along which it is formed; though, perhaps, at the expense of other places. It cut off the stream passing through the old south channel, which is accordingly, at this time, nearly silted up; and the slab behind the new wall has risen considerably, having ceased to be acted on by any current during the ebb. In so far as the tide is concerned, it is questionable if any benefit has ever been obtained by the wall. The receptacle of tide above it is too small and insignificant to be of much consequence during the ebb. But it were very possible to derive much benefit from the space in question in this way. For, by completing the embankment across to the south shore, but not so high but that it might be topped by the tide at high water, the quantity of water contained there, being allowed to fall into the channel near the Custom-house, would form a powerful scour for that channel, occurring twice every day. Or, by allowing the tide to ebb and flow by the breach near the Custom-house, the tide of flood towards the city would be greatly increased, which would materially assist the navigation.

Did I conceive the abilities of the city of Cork, and its prospects of future improvement, to admit of no undertaking of much greater extent than this, I should have no hesitation in recommending the completion of this basin without delay. The expense need not be great, and the result would fully justify it. There will be a slight bar produced in the south channel, above the outlet of the basin, and in the main channel, near the end of the Custom-house quay. But these will be kept down by the floods of the river, which in their turn, finding deep water below, will lower the bottom even above the Custom-house quay. These operations must be hastened and facilitated by dredging in the channel for ballast, especially after the gravelly stratum is uncovered.

But it must not be concealed, that this, after all, is only a temporary expedient. The quays will still be accessible only to such vessels as at present; and, though some additional water may be gained in the main channel, the larger and sharp-built class of vessels must still remain at Passage or Cove, and their cargoes be sent to Cork by lighters. So that a constant reason will exist, in favour of transferring the trade with these vessels, and of Cork in general, to a lower part of the harbour. Besides, the basin here spoken of, however large (and it contains 250 acres), must in time fill up, and its action on the channel will, at length, entirely cease. The improvements that may have taken place in the city, the property vested in buildings, &c., connected with this temporary state, will be deteriorated in value or entirely lost; nay, they may even constitute obstructions to a more perfect system, when it is at last, as it must be, resolved on.

It will be seen from the following report that the real difficulties in improving the navigation to Cork lie far out of the reach of the back-water here spoken of.

Appendix B.

Cork

No. 66.
Nimmo, on Improving the River and Harbour.

To the Commissioners for Improving the River and Harbour of Cork.

Gentlemen,

In compliance with your instructions, I have carefully examined the state of the river, from the City down to Horse-head and Passage, I have caused a hydrographic survey of this space to be made, and laid down on a scale of twenty inches to an Irish mile; upon which the banks and shoals, the channels and depths of water, are distinctly marked, as also the properties on either shore. This chart differs much from any other that I have seen, not only in its minuteness, but also in the position of channels, and depth of water. But, having personally superintended the trigonometrical observations, by which the draft of the shores is adjusted, and likewise most of the soundings, I can, I think, vouch for its accuracy.

I now hasten to lay before you an account of the existing difficulties of the navigation, and also, estimates of the expense, of the various means, not only of removing those difficulties, but of giving to the city of Cork all the perfection, as a sea-port, of which it is capable.

I have caused the shoals and course of the proposed excavations to be bored into, for a sufficient depth, to ascertain the nature of the strata, that no doubt may remain of the practicability of any operation herein proposed.

State of the River Navigation.

North Branch.—This, which is the chief branch of the Lee, becomes accessible to shipping on passing the North Bridge. The foundations of St. Patrick's Bridge have caused a dam across the channel, by which a depth of two feet water is preserved pretty uniformly above it; but this is of little use to the navigation, for the draw-arch of that bridge ebbing dry, it hardly admits a vessel of ten feet draft at the height of a spring-tide.

The fall under the arches of St. Patrick's Bridge has scooped out three holes of nine feet deep below the bridge, and thrown up a bar at sixty yards down, on which there is barely one foot water: several large stones lie on that bar. From hence the water gradually deepens to three feet opposite Nelson's street; the channel there passes to the north side, and is reflected back to the Custom-house Quay, along which we have four feet water.

In no part of this reach does the channel run close along the quay, but is bordered by a slab or bank of various dimensions and consistence; that along Merchant's Quay, in some places is forty yards wide, and two feet high by the quay above low water. The quantity to be excavated, so as to give three feet at low water by the quay, is 9,000 cubic yards; and the removal, at sixpence per ton, would cost about £300 0 0

About two-thirds of this sum will be sufficient for the north side, viz. 200 0 0

And it would be advisable to leave the centre of the river rather higher than by the quays that the current, continuing to be directed through these new channels, may tend to sweep them clean.

Also for 532 yards under pinning and piling foot of Merchant's Quay, at 12*s*. 319 4 0
640 ditto along north side, at 12*s*. 384 0 0

Below the Custom-house quay a tail of bank continues for one hundred yards to the junction of the channels; it were useless to cut away this bank, for the eddy formed there would speedily restore it.

South Branch.—The South branch is accessible for ships below Parliament Bridge; it has, in general, about two feet less water than the other. The depth at the Custom-house is but one foot and a half, and the quays being incomplete, the banks of slab are extensive. Below Morrison's island the north side forms a hollow curve, and lies fair for being swept by the river; three hundred feet of this quay yet remain to be made, which at £1 5s. per foot is . . . . £ 375 0 0

On the opposite side the quay is unformed along Nicholson's or Waters's and Foley's marshes for 450 yards; to complete this would require a sum of 1,500 0 0

And to perfect that part of the new wall above the ferry-house will cost for

120 yards at 10*s*. . . . . £60 0 0 } 127 10 0
50 yards at 27*s*. . . . . 67 10 0 }

Total, Southern quays £2,002 10 0

The slab and rubbish in front of these quays amounts to about 1,500 cubic yards, and to clear this to the depth of the rest of the channel will cost only about . . . . £ 50 0 0

To bring up three feet water in this channel as far as Morrison's island will cost for forty yards wide 1,200 0 0

And for under-pinning that quay, at 12*s*. per yard 240 0 0

To lower the bed of these two branches one foot more, and bring up four feet from the Custom-house to St. Patrick's Bridge and Morrison's Island would require about 1,000 0 0

The United River.—At one hundred yards below the Custom-house the channels unite, and are then fenced on the south by the New-wall. The united stream directing itself against the re-entering angle of the wall, and being deflected from thence to the northward, has hollowed out a pool in that angle of eight feet water; but on the other hand, after sweeping the next reach of the wall, it has thrown up a bar opposite Mr. Hargrave's quay, with only three feet water. This bar should be dredged one foot, at least, for thirty yards wide and two hundred in length; the firmer part of the stuff laid in the re-entering angle on the north side, and protected by a sheeting of quarry rubbish, forming a continuous line from Mr. Penrose's point to Mr. Carrol's quay, by which means the depth obtained by dredging will be retained.

Dredging this shoal will cost . . . . £100 0 0 } £175 0 0
The sheeting of rubbish, 300 yards . . . . 75 0 0 }

The channel now passes along the north shore, with four to four and a half feet water, is again deflected by the re-entering angle at the Glanmire road, and sweeps along that shore to the end of the wall. The early part of the ebb having at this place room to spread to the southward, its velocity is diminished, and a shoal is deposited in the channel of three feet water only extending half way to the north side, where the last part of the ebb, being confined, has still kept open a narrow passage, with five feet, by which this bar may be avoided.

To prolong the wall would only tend to throw this shoal farther down, but if thought necessary it may be cut away by dredging for about £160 0 0

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The stuff should be removed by wheel-barrows, and deposited at the back of the wall. In a few years this shoal will again collect, for which there is only a repetition of the same remedy.

The stream continues to sweep the north shore with five to five and a half feet water to the projecting part of Mr. Penrose's new wall, when, being deflected towards the middle of the harbour, and clear of either bank, its velocity slackens, and the depth lessens to three feet. The early ebb is now diverted from the channel, and sets directly down the harbour; and it is probable that the latter ebb would hardly recover its depth in this open space, were it not assisted by the waters retiring from the south slab; by means of which the depth of five and a half feet is again restored and increases to six feet, which continues until the channel strikes the south bank, at the King's quay.*

In this reach, by the early ebb setting across the channel, and the prevalent westerly winds, vessels are frequently carried ashore upon the north-east bank, even though they may have water to clear the shoal at the upper end. Were the wall continued to the King's quay, the advantage to the navigation would not be great, excepting in so far as it would afford a towing-path along the reach; the ebb would still set across the channel and north-east bank, and as the ebb stream sweeps that bank, the wall on the opposite side will have no effect in directing it, while it would be deprived thereby of the assistance derived from the waters of the south slab.

For these causes I recommend an embankment or wall to be formed on the east side of this reach, commencing at the projecting part of Mr. Penrose's wall, by the heap of rubbish (which ought to be smoothed away), and running by the extremity of the heap under Tivoli, following afterwards the contour of the channel, the shoal should, in the meantime, be lowered by dredging, and the stuff taken to strengthen the embankment.

The length of this shoal is 300 yards; to dredge it down to six feet water and fifty yards wide, will cost £500 0 0

This shoal is composed of gravel and mud; it will afford a good foundation to the front of the embankment, which may be faced with rubble stone, similar to the other walls on that shore.† If the bank be composed of gravel and rubbish, it should be five yards wide at top, and twelve feet high, sloping on either side to three times the height; or, if steined in front, it may be twelve feet wide at top, sloping three times the height eastward, and one-half the height to the channel. In either case it will cost about 4*l.* 10*s.* per running yard; and to carry it forward until opposite Dundangan, which is all that is requisite for the navigation, will cost for 850 yards, at 4*l.* 10*s.* per yard . . . £3,825 0 0

The effect of this work will be materially to deepen the channel, to prevent vessels from grounding on the bank by the thwart tide; to afford a towing-path, in conjunction with the Glanmire road, as far as the New Wall, and to protect the whole channel above the King's Quay, from the easterly swell.

The completion of the wall to the King's Quay would be a much more difficult operation than the above, since it would be necessary to expose the face of the wall to the stroke of the sea, but allowing only the same price per yard running, the expense will be . . . . £8,550 0 0 a sum nearly equal to the execution of all the other works yet mentioned. The effect of this wall upon the navigation would be but little; but there would be gained 307 statute acres of land from the sea, the revenue from which would be considerable. For this purpose, however, it would be necessary to raise the dyke to the height of extraordinary springs, which rise three and a half feet above the ordinary spring-tide; and also to secure the bank against waves, which at least may be reckoned at three feet more. The land, therefore, would not be safe until we had a bank of at least eighteen feet above low water springs entirely round it. A bank of this magnitude will sink considerably into the mud foundation, and allowing only one yard for this subsidence, the actual height to be formed is seven yards; the top may be five yards wide, and interior slope twice the height. A bank of these dimensions and steined in front to fourteen feet high, will cost 10*l.* per running yard; and to form it from the end of the wall to the King's quay, will cost . £19,000 0 0

To back up the wall to equal height, 750 yards, at 2*l.* 5*s.*	1,687	10	0
To complete other parts of the enclosure	1,000	0	0
Sluice-gate and bridge for draining	500	0	0
	£22,187	10	0

Which, for 307 acres, the quantity gained is at the rate of 72*l.* 5*s.* 5¼*d*, per acre.

On the other hand, by sacrificing about one-third of the space proposed to be enclosed, we may run a dyke from the end of the wall over to the quay at Chipley, and gain the greater and most valuable part at much less expense.

The dyke here will be on an average only five yards high, and 520 long; and if the Tivoli bank be executed the waves will be insignificant. This dyke may be executed at 4*l.* 10*s.* per running yard, and sheeting applied for 1*l.*

520 yards at 5*l.* 10*s.*	£2,860	0	0
Backing and completing the wall, 750 yards at 2*l.* 5*s.*	1,687	10	0
Making up other parts of the enclosure	1,000	0	0
Sluice and bridge	500	0	0
	£6,047	10	0

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* I am inclined to think this deep water has been partly effected by the operations in 1761; as a shoal is there spoken of as opposite to Dundangan which does not now exist.

† But I must here observe that the principles on which these walls have been constructed are by no means judicious. They are too upright; affording too fair an object to the stroke of the sea; by the descending waters of which, during the recoil of the wave, the foundations are cut away, and the stones drawn out of the wall. Where such walls are built with thin schistus, the pieces are best placed on edge, or somewhat slanting, being not so readily lifted by the ascending wave. The wall should batter at least one-half of its height, but chiefly at the foot; the upper part coming gradually to the perpendicular; and a projecting cordon is useful to throw off the spray.

Where the embankment is formed of rubbish and gravel, the foot should be secured by small piles and wattling, (or by large corvas, or baskets filled with stone,) which must be repeated at different heights up the slope. These secure the bank from washing, until, by the insinuation of sand, mud, and gravel, the whole settles into a firm mass.

If the embankment be made of sand and mud, it must be sheeted, to at least a yard deep, with gravel or rubbish, secured in, the above manner, the sheeting on each side and the interior mud being made to rise together in the execution. The exterior slope for these last dykes must be three times their height, within Black Rock. Four times the height will be required for those in Lough Mahon, where there is a greater swell. I have inserted, on the chart, sections of these forms of embankment.

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Which, for 182¾ statute acres, the quantity enclosed, is at the rate of 33*l.* 1*s.* 10*d.* per acre, and it cannot be doubted that the land thus gained is, even for pasture, worth at least three times that sum.

If at any future period an extension of these embankments be projected it will be advisable first to enclose as far as Clifton, by which 80 acres more will be obtained. The enclosure of the remaining 44 acres will be much more expensive; and I should by no means wish to see the whole of this strand cut off until the effect of its back-water upon the channel near the King's Quay shall have been for some time experienced. There can be little doubt but that channel when thus contracted will have its depth speedily restored, or much increased, so that a deep pool is likely to be formed at this place, the importance of which will be seen in the latter part of this report.

Below this quay the channel sweeps by the south shore, and attains the depth of eight or nine feet, which continues to the baths; beyond them there is eleven feet water, after this, the channel, being reflected from the steep limestone rocks of that shore, and shooting round the point of the Black Rock, widens considerably, and diminishes in depth to seven feet, which continues beyond the junction of the river Glanmire.

Along this reach no operation is required at present to increase the depth, though the formation of a towing-path would be of advantage. For that purpose the rubbish of the slip at Pleasantfield should be prevented from advancing into the river, and made to extend on either side towards the King's Quay and Ordnance Wharf. In the meantime the present road, with warping rings along the shore, will in some degree answer the purpose.

Recapitulation of Estimates for the Works in the River above Black Rock.

		£	s.	d.
1.	Excavating at bottom of the quays along the north branch	500	0	0
2.	Under-pinning these quays	703	4	0
3.	Completing Warren's quay on the south branch	375	0	0
4.	Repairing the wall	127	10	0
5.	Forming a quay on the marshes	1,500	0	0
6.	Deepening the south branch along the quay	50	0	0
7.	Ditto ditto throughout, to three feet water	1,200	0	0
8.	Under-pinning that quay	240	0	0
9.	Deepening both branches to four feet	1,000	0	0
10.	Dredging shoal at Hargrave's quay	175	0	0
11.	Ditto ditto at the wall end	160	0	0
12.	Ditto ditto under Woodhill	500	0	0
	Total for deepening and repairing of quays	£6,530	14	0
13.	The embankment wall from Tivoli	3,825	0	0
	Total for navigation only	£10,355	14	0
14.	Embanking 182¾ acres on the south slab	6,047	10	0
		16,403	4	0
	Contingent expenses and superintendence, at 20 per cent.	3,280	12	9
	Total	£19,683	16	9

Lough Mahon.—Below the Black Rock the channel assumes a new appearance, widening into an expanse of from 1,000 to 2,000 yards in breadth, at high water, by 5,000 yards long; and even the surface of low water is about 1,000 yards wide.

In this open space, which receives the name of Lough Mahon, the river has little power to preserve its channel: it has accordingly become the receptacle for the greater part of the deposition. It is obstructed by banks and shallows, over which there is only a depth of four feet; and the formation of a proper channel through it is by far the greatest difficulty in improving the navigation to Cork.

To have a proper conception of this, we must attend to the general structure of the country composing the basin of the river Lee.

The ridges of the schistus rock, which constitute the basis of all the south of Ireland, run nearly east and west, and usually confine the channels of the river to the same direction. But they are intersected by various gaps and glens, which permit the river, in many cases, to cross the ridge and approach the sea to the southward. One of these gaps, or openings in the schistus, forms the entrance of the harbour of Cork; another, the channel from Monkstown to Passage; and a third, the bed of the Lee, at Firmount, above its junction with the Bride. The schistus hills rise quickly to the height of about 200 feet above the level of the vales; and, in general, the bottom of these vales is a gravel, and alluvial soil composed of the spoils of the schistus; and, to judge from the steepness of the sides of these hills, this alluvion is probably of great depth.

But in several of these vales, a bank of limestone is found rising in the centre of the hollow, and running with many inequalities along the bottom. The vale of Cork affords one of the most remarkable instances. This limestone bank, commencing in the bog of Kilcrea, pervades the vale, with little interruption, until it meets the sea near Youghal. At the Ovens this limestone becomes continuous, extending under the south suburbs of Cork, and as far as Black Rock. The hollow on the north side forms the channel of the Lee; that on the south is drained by the Douglas stream, up which the tide flows for two miles in a shallow creek of 400 or 500 yards wide.

The breadth of the bank of limestone is about 2,000 yards. Beyond the peninsula of Black Rock it sinks under the level of low water, and this permits the Lee to cross it and unite with the Douglas stream. Though the limestone disappears in this place, I have little doubt of its continuing, at no great depth, until it rises again in the Little Island, of which, also, it forms the basis, and from which it passes into the island of Foata, and may be felt in the intermediate channel.

The same limestone bank forms a part of the northern side of the Great Island, readily distinguishable, by its low plains and gentle swellings, from the steep ridges of schistus which form the central and principal part of that tract.

Now, if the configuration of the shoals in Lough Mahon be attended to, as laid down in the chart, where I have distinguished the depth of water by continuous lines, it will be perceived that the great body of the shoal lies exactly in the course of the limestone bed; for, while in the direction of the

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Douglas and Black Rock channels we have eight feet of water and upwards, we have between them only four to six feet water, and the Meelagh bank dry three feet at low water.

It will also be observed, that the southern edge of the shoals, as, for example, the line of six feet water, is almost exactly in the line of the southern edge of the limestone bank, viz.:—from the point of Lakeland to the point of Carrigagreenaan. On the northern edge we have shoal water, extending the whole way over from Black Rock to the point of Little Island, nowhere exceeding four feet in depth. And, in the channel north-east of Meelagh, the depth does not anywhere exceed seven feet at low water springs.

From these observations, we might be induced to consider the shoal waters in Lough Mahon as the result of the original formation of the rock basin; and that, in fact, they were caused by the configuration of the limestone rock itself. But, having bored over all this tract, I find that it is covered by a deposition of mud, sand, and gravel, of so great depth, that no obstruction is likely to arise, to any proposed excavation for improving the channel, by the interference of harder strata. That, on the other hand, it would appear the figure of the shoal is chiefly owing to the course of the tides: the early flood setting up the Southern and Douglas channel, while the ebb, being shot off by the point of Black Rock, sets constantly down the eastern channel along the Little Island. The shoal of the Meelagh and the flats at either end, have arisen by deposition in the eddies where these tides meet: so that the existence of an excavated channel, could not be permanently secured without expensive works, to direct the stream of ebb and flood, give a new course to the depositions, and, at the same time, afford a tracking way to bring ships through the passage, which must necessarily be of no great width.

To construct walls or banks of this kind for the north channel, would be an operation of great difficulty and expense. It would deprive light vessels of the advantage which the width of that channel now affords, in beating through with foul winds, and would not be attended with any collateral benefit.

The south channel in Lough Mahon seems a better subject for an undertaking of this kind; and works constructing there would in nowise interfere with the usual navigation. Though narrow, this channel is in general deeper than the other, excepting at the upper end, where there is a shoal of 300 yards with three feet water only. This shoal, composed of fine gravel and sand to the depth of 18 feet, may be cut away by dredging, and the stuff excavated, being deposited by boats along the western side, will assist in forming a bank, which may be faced with stone, or secured by hurdle work, having a very gentle slope on the outside to prevent injury from the waves. Even with a slope of four to one, this bank will admit of being used as a towing-path, and may be carried forward, by degrees, to the Douglas channel, and from thence to the south shore, near the bounds of the city liberties, where deep water is met with.

This bank would enclose nearly 600 acres, inclusive of that in the Douglas creek, the waters from which might be let off by a sluice. The bank affords an obvious method of distinguishing the channel, and is a trackway for ships ascending the river with westerly winds. But, as before observed, these two latter objects may be obtained by a bank of much less strength and expense than would be required for securing the enclosed space from inundation.

The expense of such an embankment from the Black Rock to the Douglas channel would be	£25,000
And to carry it forward to the deep water near Ardmore would require an addition of .	18,000
To dredge the south channel so as to carry seven feet water throughout, viz.:—from the junction east of Black Rock to the point near Mr. Downe's, 1,500 yards in length, three feet average deep, and 56 wide, would cost	5,000

and the river would then admit ships of 20 feet draft to come up to the King's Quay.

To produce the same depth in the north or main channel, it would be necessary to dredge not only at the flats near Barry's Point, but also at the north end of the Meelagh. The expense would be more than double the former, even at the same width of 50 yards, and I have great doubts whether his channel across the flats could be easily preserved.

Until some such operation as this is performed, by means of which the shallows at either end of the Meelagh may be overcome, it is evidently unnecessary to expend labour in procuring a greater depth in a higher part of the river. The works I have already specified are sufficient to admit any ship which can now get to Black Rock to pass up to the quays at the city; and nothing further should be attempted until the success of the operations in Lough Mahon be ascertained. Even then, if a greater depth of water at the quays be sought, it will be necessary to deepen the whole channel from Tivoli, or even Dundaugan; an operation which is, perhaps, too expensive for a benefit which cannot be permanent; for the river, being sunk below its natural train, will constantly tend to fill again, and even the increased depth of four feet along the quays, will be found to require the frequent application of the ballast lighters. But the great quantity of ballast required for the shipping, being about 20,000 tons per annum, forms a powerful aid to our undertakings; and as the shoals above Black Rock will soon be cut out, the flats in Lough Mahon become the place for the supply, so that in process of time they may, perhaps, be sufficiently lowered, as to preclude any desire for embankments.

Proposal for a system of Wet Docks at the City, with a Canal for Large Vessels to the Deep Water.

From the consideration that no justifiable expense can give any other than a dry harbour in the channel at the quays, in which vessels must be allowed to take the ground every tide, it is my opinion that a system of wet docks is that to which alone the city of Cork must look as a radical cure for the inconveniences of the present navigation. Though this system is not without difficulties, there are few situations which afford so many facilities for carrying it into execution; and the advantages of such docks have been uniformly found so great, wherever they have been tried, that few of the great ports are now without them.

I have prepared a plan of this kind, for docks and a navigable canal to the deep water in the lower part of the river, which may be executed by degrees, so that the benefit will be early felt; and, upon the final completion of the whole scheme, ships of any size now frequenting the harbour, may be brought at once up to the city.

I have approximated the site of the docks as much as possible to the city, and especially to the Custom-house, although the ground thus chosen be not entirely public property. But if any difficulty arise from this, the docks may be removed farther to the eastward.

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The first, or upper dock, is therefore formed at the back of the wall opposite to the Custom-house. It will be 200 yards long and 110 yards wide. The area is four and a half English acres; being nearly the same as the Salt-house Dock at Liverpool. It will contain 45 sail, of above 200 tons. The quays will be 600 yards in extent, and will accommodate 30 sail in double tier along them. The quay is 50 feet wide; surrounded by an enclosure of warehouses of 50 feet wide. The back of these warehouses being formed into a high wall, the whole being perfectly insulated by surrounding streets, and the entrances closed regularly by land and water, a considerable security will be obtained against accident or depredation.

Between these warehouses and the south branch of the Lee, a quay is left, 50 feet broad, that coasters and small craft may conveniently load or discharge at the back of the warehouses.

I should suppose this establishment will be principally occupied by the revenue. No more convenient place could be found for depositing spirits, tobacco, wine, &c. upon bond. The extent of warehouse, if all are completed, will be 2,300 feet long, by 50 feet wide. For ready communication with the Custom-house, I have designed a light iron bridge, of three arches, of which that next the dock opens by turning on a pivot, and, being only closed during the office hours of the Custom-house, admits, at all other times, of vessels passing up and down the river.

As this bridge abuts in the rear of the Custom-house, the passage along the south side may be stopped during office hours; the Dock and Custom-house will then be parts of the same enclosure, and, if thought necessary, all goods transferred from the warehouse to the city may be made to pass through the Custom-house itself.

From these considerations of security to the revenue, I can have no doubt but a liberal aid will readily be granted, towards carrying so beneficial a scheme into execution.

To the eastward of the Upper or King's Dock, I have designed one on a still larger scale, for the purposes of general trade. It will be 1,120 feet long, and 350 feet wide. The area is nine acres, and it will contain 90 sail; of which 50 sail may be accommodated in double tier along the quays, or 70 sail in triple tier.

The area of these two docks is not greater than that of the two branches of the Lee, below the bridges; viz., the upper dock nearly equal to the south branch, between the intended Nelson-street Bridge and the lower end of the Custom-house Quay; and the lower dock equal to the north branch, below St. Patrick's Bridge. Instead, therefore, of finding these docks too large, I believe that a considerable extension of them will be resolved on, whenever the value of the dock system comes to be felt and understood. But if funds for the completion of the whole cannot be immediately procured, the upper dock may be formed first, with an entrance into the lower dock, and a lock from thence into the river; the second dock and other works may be formed by degrees, without interfering with the first, or obstructing the navigation.

From the lower dock a canal is designed to lead down to the present channel of the river in the neighbourhood of the King's Quay, communicating there by a lock of 40 feet wide and 150 feet in the chamber. The canal will be 40 feet wide at bottom and with slopes of twice the depth; so that with 15 feet water, the surface width is 110 feet, and 130 feet wide with 20 feet water. By means of this canal, an extensive addition will be made to the floating harbour, the length being 2,300 yards, and breadth nearly that of the south branch of the Lee. The banks also though sloping have not the inconvenience of those in a tide river, for the water in the dock and canal is at all times retained at a uniform height. The southern quay of the dock may, at any time, be prolonged along the side of the canal.

That a regular plan may be followed in the buildings hereafter made in the neighbourhood of these docks, I have laid out a street along the edge of the lower dock and enclosure of the upper one, of 100 feet wide; this being at once a road or street and a quay. It connects with the new road now forming across the marsh, and below it may be prolonged to the King's Quay, since the excavation of the canal will supply sufficient materials. A passage of equal breadth runs from this street between the two docks, and terminates on the wall, opposite the extremity of Lapp's Island. In the middle of this road an iron swivel bridge is necessary to cross the communication between the docks.

Between the lower dock and the river, three compartments of building are marked out 120 feet, wide, and having, on each side a quay of 60 feet, viz., one to the lower dock, and the other formed by the wall. The value of this ground is likely to be considerable, from its connecting with both of these: the breadth admits of a building lot towards either. The remaining compartments are laid out so as to combine regularity with convenience and health. The principal cross streets are 40 feet wide; the back lanes 30 feet.

In deciding upon the depth of water for this floating harbour, we are directed by the state of the river navigation below its entrance. In the main channel, north of the Meelagh bank, we have only four feet on the shoals at low water of spring tide; this tide rises eleven feet four inches only, except in extraordinary cases, when it is three and a half feet higher, the waters being pent up by south-easterly winds. It is evident, then, that no vessel, drawing more than 15 feet water, can be brought above the anchorage off Horse-head. If, therefore, we can secure 15 feet water, at all times, in the docks, it will answer every purpose which at present can be looked for. I propose then to lay the sill of the entrance lock in 6 feet water, continuing the same level for the bottom of the docks; and the whole being filled at high-water springs, will have 17½ feet water throughout. The area is such, that 100 sail may pass out or in, during two hours before and after high water, without lowering the surface one foot; and this number is far more than may be expected to pass in the interval between spring tides.

Could a supply of water be obtained from the Lee, or elsewhere, above the level of spring tides, some excavation might have been saved, and the whole would have been less expensive, and, perhaps, more useful; especially in facilitating the construction of graving-docks. This, however, upon a careful examination, I conceive to be impracticable in any other way than by machinery. Nevertheless, we are in no worse condition in this respect, than at London, Liverpool, &c. there being few floating docks with any other supply than that derived from the spring tide.

The deep water below the King's quay (where there is 11 feet at spring ebb, and where there will probably be much more after the Tivoli dyke is executed) will render the formation of an entrance basin unnecessary; since vessels using it will generally be water-borne in that station.

The strata have been examined to the depth of 18 or 20 feet, and consist of a bed of mud of 6 feet, covering a fine muddy gravel of unknown depth. On those data, I have formed the following—

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Nimmo, on Improving the River and Harbour.

Estimate of the Expense of the Docks, at the Back of the Wall, for 100 Sail of Ships, and of a Canal from thence to the King's Quay; the whole to have 17¼ feet depth of water.

	£.	s.	d.
Excavating the upper dock	4,400	0	0
Masonry in the stone quay upper dock	3,720	0	0
Swivel bridge across the entrance and foundation of ditto	2,000	0	0
Entrance lock to the river	8,500	0	0
Excavating the lower dock	9,138	10	0
Quays for ditto	5,840	0	0
Swivel bridge across the lock	1,500	0	0
Excavating the canal	9,333	6	8
Dressing banks, puddling, and lining	2,000	0	0
Sheeting outside of ditto in river	1,000	0	0
Lower entrance lock, complete	10,000	0	0
	57,431	16	8
Contingencies, superintendence, &c. 20 per cent.	11,486	7	4
Total for docks and canal	£68,918	4	0*

We have now to consider the extension of this plan, to the deep water below the shoals of Lough Mahon.

If, by dredging on the flats, or at the east side of Black Rock, we succeed in obtaining a depth of 7 feet at low water, vessels drawing 18 feet may be brought to the King's Quay, and enter the canal. In this case, we may either deepen the canal, or raise the water within by artificial means; for which purpose, the tide affords a ready motive power; and we can form ponds on the slab, to work a water-wheel, which will raise all the supply wanted. If the surface of the canal be raised in this way 6 feet above the spring-tide level, graving docks may be made on the side next the river, to admit vessels of 17 feet draft, and will run dry at low water.

But the communication with the harbour at Passage will still be over a bar of 7 feet at low water, and be liable to much inconvenience; the only effectual cure for which is to continue the still-water navigation by a canal passing round the point of Black Rock, and across the Douglas channel, to near the bounds of Ardmore. To accomplish this, a new channel must be cut for the river, from its present bed opposite Dundangan, to the separation of the channels east of Black Rock; the present bed, for that distance, becomes part of the new canal; afterwards, we may either adopt the south channel as the line of the new canal, forming embankments on the Meelagh, and on the south strand, or we may cut the canal along the south strand, and form a bank between it and the sea. In either case, an entrance lock will be formed in the deep water, nearly opposite to the bounds of the city liberties. I have made estimates of the expense of both, founded upon the cost of similar works executed for the Caledonian Canal, and the result is as follows:—

Estimates for a Canal from the King's Quay to the deep water in Lough Mahon; to be 50 feet wide at bottom, and have 20 feet water.

1st. *By embanking the Southern Channel.*

	£.	s.	d.
New waterway for the river	18,666	13	4
Making the canal and the dykes across the present channels, and along the shoals to deep water	76,730	0	0
Entrance lock	12,000	0	0
	107,396	13	4
Contingencies and superintendence, at 20 per cent.	21,479	6	8
	£128,876	0	0

2nd. *By excavating along the South Strand.*

	£.	s.	d.
New waterway for the river	7,666	13	4
Eastern embankment and dykes	47,600	0	0
Western ditto, and completing canal	11,250	0	0
Lock	12,000	0	0
	78,516	13	4
Contingencies and superintendence, at 20 per cent.	15,703	6	8
	£94,220	0	0

ALEXANDER NIMMO.

No. 67.

Report made to the Cork Harbour Commissioners on the State of the River and Harbour, by JOHN KILLALY, ESQ., *Civil Engineer, on the 23rd May*, 1821.

No. 67.

Killaly, on Improving the River and Harbour.

I BEG leave to state for the information of the Commissioners for improving the Port, Harbour, and River of Cork, that from my examination of the river between Horsehead and the city of Cork, aided by Mr. Nimmo's map and report, I am led to conclude that the most eligible mode of effecting navigable communication with that city for vessels of large burden, will be by the construction of a still-water navigation, commencing near Black Point, and terminating opposite the Custom-house Quay. The bottom of the canal I propose to be on a level with the low water of ordinary spring tides, and its depth of water to be 18 feet, having a tide basin and lock at its commencement, and a floating dock and lock at its termination; the tide basin to be capable of containing 25 vessels, and the floating dock 100 vessels, of 300 tons burthen each, the latter affording quayage for upwards of 50 vessels in double tier. My reasons for recommending the commencement of the canal near Black Point, rather than at the King's Quay, are that vessels of large burden can come up to Black Point at ordinary spring tides without interruption, whereas the navigation to the King's Quay must always be attended with danger and delay from the present defective state of the channel east of Meelagh Bank; and the difficulty, I might almost say the impracticability, of opening and preserving a safe and commodious passage in that quarter, as also from the circuity and narrowness of the channel westward of Black Rock.

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* In the event of this plan being followed, the embankment across to Chipley will be merely drawn to join the canal bank.

I should not think, however, of recommending so great an extent of canal as that now proposed, (nearly three miles in length,) if a sufficient navigation was attainable in any other way, or if the proposed undertaking was subject to the casualties and uncertainty ever attendant upon the works of art that are meant to counteract the operations of nature; but here all is within the compass of mathematical certainty. A level for the bottom of the canal is assumed, by which the great difficulty and expense of working in water is avoided; a supply of fresh water being procurable, sufficient for maintaining the level in the canal to the height of 18 feet above the ebb of ordinary spring tides, even allowing for the great increase of trade that such a measure is calculated to induce. Moreover, in order to lessen the expense of this undertaking, I propose that the canal shall have only an outer bank, allowing the water to assume its own level on the land side; the Commissioners paying of course for whatever damages it may occasion. The savings which would result from the adoption of these principles are so obvious, that I deem further observations unnecessary.

I have much pleasure in stating that the proposed improvements may be accomplished for 103,500*l*., a sum very small in proportion to the advantages which the trade of Cork and the revenues of the kingdom would derive therefrom; but these being subjects which the Commissioners are so fully capable of appreciating, I shall not detain them by dwelling thereon. I may, however, be permitted to point their attention to a matter of great importance to the shipping interest, namely, the construction of graving docks, which the proposed elevation of the canal water (seven feet above the tide) would be peculiarly favourable to.

In the estimate, which I have the honour to lay before the Commissioners, an ample allowance is made for paving the outer part of the canal bank, to prevent its being injured by the action of the tide water; but if the rampart was executed, which I have described on the accompanying map, extending from the eastern extremity of the present wall to the point at Clifton, no pavement westward of that point would be required. This saving should nearly cover the expense of forming the rampart, raising the present wall and constructing sluices, with such other matters as may be requisite for reclaiming about 140 Irish acres of the South Slab; an undertaking for which there appears to be strong inducements, even if no canal was in contemplation.

Although the floating dock and lock, near the Custom-house, would in themselves be highly desirable, I should not recommend their construction, unless a canal from thence to the deep water was absolutely decided on; in that case, I see no objection to their being executed in the first instance, the bottom of the dock to be on a level with the low water of ordinary spring tides, and the lower cill of the lock to be 4 feet under that level (which is somewhat below the bed of the river at this point); and further, as the water in the floating dock will be maintained at the height of 18 feet above low water, by means of the supply already mentioned, the benefit of efficient graving docks may be had previous to the completion of the canal.

Conceiving that a bonding dock of moderate dimensions might be desirable, I have given a design for one of that description convenient to the Custom-house, connected with another calculated for general trade; the water surface in each to be 18 feet above the level of low water. The bonding dock being chiefly for the security of the revenue, I should suppose its expense, and also a portion of that which must be incurred in forming an entrance thereto, would be borne by Government; in that case, the amount of my general estimate may be set down at 90,000*l*.

I have also given a sketch of the manner in which part of the south branch of the Lee might be converted into a floating dock, and a new course formed for the river; the probable expense thereof would be 26,000*l*.; but as this project could not be connected in any feasible manner with the future construction of a still-water navigation, I do not feel myself warranted in recommending it.

I have, &c.,
JOHN KILLALY.

To Henry Hardy,
Secretary to the Harbour Commission.

ESTIMATE for a Canal from the City of Cork to Black Point, 106 feet wide at bottom, with 18 feet depth of water, including the expense of a Floating Dock for 100 Sail of Ships, and of a Tide Basin for 25 Sail; also 2 Locks, one at each extremity of the proposed Navigation.

	£.	
Earthwork.		
Excavation for floating dock and upper lock	3,700	
Sinking and embankment in canal	14,900	
Excavation for lower lock tide basin and entrance thereto	3,200	
		21,800
Masonry.		
In floating dock	16,000	
In upper lock, including gates, machinery, swivel bridge, &c. . . .	12,500	
In lower lock, including ditto ditto . . .	13,000	
In tide basin and entrance thereto, including gates, &c.	11,500	
Pavement for protecting the canal banks, &c.	9,200	
Allowance for coffer-dams, keeping out water, &c., say	6,000	
		68,200
Contingencies, including purchase of land and houses eastward of floating dock, also allowance for superintendence, &c. &c.		13,500
Total		£103,500

JOHN KILLALY.

Henry Hardy,
Secretary to the Cork Harbour Commissioners.

No. 68.

Mr. OWEN's *Report, made to the Cork Harbour Commissioners.*

No. 68.
Owen, on Improving the River and Harbour.

SIR, *Cork, 17th June,* 1836.

Conformably with the request of the Harbour Commissioners of this Port, which I had the honour to receive through you, I have inspected the part of the river between this city and Black Rock, to which latter place it is proposed to extend the sea wall,—in the performance of this duty I have received every assistance and information from our Superintendent, Mr. Alex. Deane.

In submitting the accompanying plan, showing the direction of the proposed wall, I beg to state that, after full consideration of the subject, I would strongly recommend, that in the portion of the wall about to be commenced, a line should be adopted, so as to afford the opportunity hereafter of widening the river, from the angle marked A on the map, nearly opposite the eastern extremity of the Custom-house, to its present termination at B:—this I consider absolutely necessary to render this portion of the river convenient and suitable for the large class of vessels which at present trade to this port. This part of the river is now so narrow, that the action of the paddles of the steam-vessels, even under the diminished speed, to which they are very properly restricted, produces a swell and surge that greatly disturb the quiet and repose of vessels alongside the quay, and is productive of considerable danger to boats and small craft that happen to be subject to its influence; besides this, the river, in the part referred to, is much too narrow for the convenient navigation of the large class of vessels which the trade of this important port requires.

The expense of the proposed widening will be small compared with the advantages which will be derived, and the improved appearance which will be thereby effected.

I would also beg to add, that, in adopting a regular segmental curve for the line of the sea-wall, it will possess the advantage of facilitating the project of the proposed railroad; and should the coast line be ultimately decided upon, the railroad may in that case be constructed in a line parallel with the near wall, and thus somewhat diminish the cost and improve the character of the project.

In the construction of this wall every unnecessary expense should be avoided, regarding only what is necessary for its stability; and it is on this principle that the specification has been formed, for the purpose of calling for proposals for the execution of the work.

It will probably be deemed requisite to provide an arched passage in the wall of sufficient capacity to admit of lighters and small craft passing at half flood, for the purpose of communicating with the south shore.

It would also be necessary to construct a flight of steps, at intervals of probably a thousand feet, to afford a convenient communication with the water.

The sea-wall and the necessary filling in the rear to support it, which will be done in the ordinary course of dredging now in operation by the Commissioners, will be found of great advantage, as a trackway for hauling sailing-vessels when the wind is adverse; a convenience that I apprehend must have been long wanted in this portion of the river, where there is not sufficient width for large vessels to work.

I have, &c.,

To Henry Hardy, Sec., &c. JACOB OWEN.

No. 69.

Address of Shipowners, &c., to the Harbour Commissioners of Cork.

No. 69.
Address to the Harbour Commissioners.

GENTLEMEN, *12th December,* 1836.

In conformity with resolutions this day adopted, at a meeting of the shipowners, ship-masters, traders, and others interested in the preservation and improvement of the river, we take leave to address you.

In common with the rest of the inhabitants of Cork, we have, for many years back, cordially borne testimony to the valuable services rendered by your Board, through the medium of works, suited to the objects of your appointment. We have seen quays erected, the channel in many parts deepened, and obstructions removed; and, although you did not hold out to us the expectation of a large expenditure at any one time, yet we confidently anticipated that, by the same course of proceeding you had heretofore followed, we should in due time derive all the advantages which our river should be capable of affording, from further improvements, the result of an advanced state of scientific knowledge, and the application of funds enlarged by the increase of trade.

We recently heard, with much gratification, that you had resolved upon affecting, within a season or two, all the practicable improvements of the navigation between Cork and Black Rock, and that for this purpose you had determined to expend a sum of between 20,000*l.* and 30,000*l.*

To our great dismay, however, we perceive that works have been commenced, which, if proceeded in, as present appearances seem to indicate, will, in our judgment, not only endanger the navigation of the river between Black Rock and the city, but make its destruction inevitable.

We observe that a wall has been commenced, at the termination of the Navigation Wall, departing from the present channel, and proceeding through the Southern Slab. To what extent it has been determined to carry it, we can only speak from rumour; but it has been publicly reported, that your Board designs to defray the expenses of the wall, to take part of the river opposite the King's Quay; and that you have expressed your approval of its being continued at the expense of a private company, and for their private purposes, to the Ordnance Ground, beyond the open space opposite the convent.

It has been stated, that the wall to be formed is to advance considerably into the channel, in one of its narrowest parts, and that it is intended to enclose by its means all the Southern Slab.

There can be no doubt that alterations such as these would produce a most important, and, as appears to us, destructive change in the navigation of the river; for it must be obvious that if the wall be made to advance into the channel, the stream must receive a new direction; probably the waters would be reflected northward, and spread over the Slab lying in that direction; whilst an eddy would be produced where it would be most injurious, and the mischief would be to such an extent aggravated, by cutting off the benefit now derived from the waters retiring from the South Slab, that a totally new system of works would, as we apprehend, be made necessary for the preservation of the navigation.

We beg to remind you that, in addition to the evils we have pointed out, the wall as constructing would not only be at variance with the improvements you have heretofore effected, but would exclude any future improvement between Blackrock and Cork; for you will please to recollect that the channel near the city has been deepened to 21 feet, whilst the wall now erecting is but 17 feet over the mud; so that any means taken to form a channel near the wall now constructing, of a depth equal to the portion of the channel above it, would prostrate the works now in progress.

APPENDIX B.

CORK.

No. 69.
Address to the Harbour Commissioners.

It has been alleged, that the proposed quay will be serviceable as a towing-path; but it is obvious that if a channel of 21 feet should be cut at such distance from the wall, as to avoid undermining it, the wall would be unavailable for any such purpose to vessels requiring the deep water.

We beg respectfully to represent, that the large funds under your control were placed at your disposal for the express purpose of preserving and improving the navigation of the river. We are far from saying that it would not only be justifiable, but praiseworthy, of a public Board to make (if practicable) the works executed under their directions available for public benefit beyond the direct object in their care; but we do say, and with great respect insist, that it is the first duty of every Board, with regard to any project submitted for its consideration, and intended to effect purposes beyond the legitimate one to which its funds are applicable, to ascertain that it really will produce the benefits which are proposed in reference to the objects under the care of the Board; and, above all, that it shall neither be calculated to defeat such objects, by immediate consequences, nor prevent any future improvements which changes of circumstances may make desirable.

Viewing the subject in this light, we do not hesitate to say that, as persons deeply interested in the preservation and improvement of the river, we are filled with alarm at the apparent endeavour to reconcile objects which, to our view, appear altogether incompatible.

It is said that you have given your sanction to the establishment, upon the Navi gation Wall, (the expense of the continuation of which you are now defraying,) of a railway to extend from the city of Cork to Black Rock, and that such railway is to run close to, and parallel with, the quay.

It appears to us. Gentlemen, that such a project cannot be carried into execution, without producing most injurious consequences.

It has been dwelt upon as the chief, perhaps the only merit, of the proposed wall, that it is to answer as a towing-path to vessels in the reach between Black Rock and Cork. We have already stated that the line of the proposed wall deviates from the channel in one part, and passes through it, diminishing it considerably in another. Before, therefore, it can be available for such a purpose, a new channel, in an untried direction, and the result of which no man can tell, must be formed; even then the depth must be limited to 17 feet, (as any greater excavation would bring down the wall,) and consequently the towing-path cannot be available for vessels of a greater draught of water; but what is to be thought of a proposition which, if adopted, will make the wall useless for craft of any description?

A railway, it would seem, is to be erected within 60 feet at the widest part, and 30 feet at another part of the edge of the quay, and it is between this railway and the water that horses are expected to act in towing-vessels.

The intercourse by the railway is calculated upon as requiring an engine and train to start every quarter of an hour, from Cork and Passage, causing, we may say, an almost uninterrupted succession of these vehicles backward and forward.

Is it to be supposed, Gentlemen, that horses will remain quietly on the wall, whilst such machines are whirling by them? Must not the inevitable consequence be, that the horses will themselves be driven by fright into the water?

For all purposes of a towing-path, therefore, this expensive quay will be unavailable. But this is not all, it will not answer even as a road to Black Rock, although the quay should extend to it; for it is obvious that, with such perpetual noises on the railway, no one would think of risking his life on horseback, or in a carriage on the quay.

For what purpose, then, is this quay to be erected, if it will not improve the navigation, will not serve as a towing-path, nor cannot be used as a public road?

The intention with which it was designed may, perhaps, be conjectured by an examination of its form as submitted to you.

It is a well-known fact that a straight channel will be less liable to deposits than a curved one. The opportunity for making a direct line of channel between the termination of the Navigation Wall and the King's Quay was afforded; but, instead of such a line being adopted, the line laid down is throughout a curved one.

It is impossible to account rationally for the suggestion of a course so disadvantageous to the river, otherwise than by attributing it to the fact that a straight line would not in some places have left within it sufficient space for the formation of a railway.

Rumours have been set afloat of advantages to be derived by the citizens of Cork from the works in progress, through the medium of the slab to be enclosed. Such a representation we apprehend cannot be justified by any resolution of your Board. The wall now in progress would, from its limited height, be constantly out-topped by the tide, and we are not aware of any fund applicable to the raising three or four hundred acres of land, to even that height; and, unless it shall be raised, we cannot imagine that such a quantity of slab, kept in a continued state of moisture by the drainings from the adjoining grounds, and the occasional overflowings of the tide, can be anything but a nuisance and a noxious nuisance, destroying the general beauty of the river and of the walk upon the Navigation Wall recently become interesting, and operating as a fertile source of disease; whilst the channel will be deprived of a supply of water that at ebb has been found most valuable. But, even if the expense of raising the slab to a sufficient height is to be encountered by the citizens of Cork, why are they not to have the benefit of the river as their boundary? Why is the most beautiful feature in the whole prospect to be cut off from them?

If one standing on the present Navigation Wall imagines a wall erected along its margin, shutting out the view of the channel, with its shipping, boats, &c., and excluding the Glanmire district, he may have an idea of the loss which the citizens would sustain if a railway were interposed between the ground which they should, at an immense expense, fill in, and the river.

If, Gentlemen, it be deemed advisable to try an experiment upon the river, by varying its channel and making other changes, the effects of which nothing but experience can demonstrate, at least do not commit yourselves irrecoverably.

If the wall be erected, and the space within it be left unchanged, by transfer to private individuals, then such alterations, either in respect to the navigation or to the slab within it, as may be deemed advisable, may from time to time be made; but commit yourselves once to a private company, by permitting them to establish a railway along the line, and all change, however needful for the benefit of the river, or the enjoyment of the citizens, is forbidden, even though it should be recommended by all the scientific men in the empire. And for what object are all those sacrifices to be made? To enable speculators in a railway to use, without cost, works which the public erect.

We are very far from undervaluing the advantages which the facilities for conveyance of passengers and goods by railways may afford; but we can by no means concur in the opinion, that a navigable river, capable of almost unlimited improvement, is to be considered secondary to, much less that it

APPENDIX B.

CORK.

No. 69.

Address to the Harbour Commissioners.

should be sacrificed for, the purpose of insuring the success of a railway. And we cannot shut our eyes to the fact, that the individuals who have brought the present project under your consideration, and seek to obtain your sanction to the erection of the railway, are directly interested in advancing the land conveyance at the expense of the navigation of the river.

We think it right to remind you, Gentlemen, that the Legislature has invited those public bodies, to whose care the improvement of harbours has been committed, to make efforts equal to the necessities occasioned by increased trade, and commensurate with the capabilities of their respective rivers, and has, with a view to forward so important a design, from time to time appropriated extensive funds, to be advanced at a low rate of interest, repayable by distant instalments.

Limerick and Galway have wisely taken the benefit of the encouragement thus held out; and provision has been made in them, not only for the general improvement of the navigation, but for the establishment of floating docks. Yet no effort whatsoever has been made to obtain, for the improvement of the port and river of Cork, any portion of the money appointed by Government for such purposes.

We have been informed that it is practicable to construct, at a moderate expense, a channel in a direct line with the northern branch of the river to Black-rock Castle; that such a channel could, if it were deemed advisable, be deepened to 25 feet, and that, in consequence of its being formed without curve or angle, it would be regularly swept by the currents, and any accumulation of deposits be thereby prevented, and it has been represented that such a measure would afford the incalculable advantage of making available, as a floating-dock, the greatest portion of the space between the Navigation Wall, and the northern side of the river.

It is not for us to suggest any particular project for the improvement of the navigation; but we may with confidence say that the extent of the slab between Cork and Black-rock Castle, and the absence of any impediment of rock, or interference of private property, combine to offer unusual facility for the execution of any works that men of science and experience may think suitable; and it may be considered certain that the Commissioners, to whom the funds for such works have been entrusted, will not withhold from Cork that aid which they have extended to Limerick and Galway.

We feel assured, gentlemen, that we have said enough to call your anxious attention to the proposed works. It happens, fortunately as we conceive, that the advanced state of the season will render further progress in them impracticable, within the present year. We, therefore, earnestly entreat, on behalf of ourselves, and all others interested in maintaining the navigation of the river, that you will avail yourselves of the present interval to obtain the opinion of men of science, who have been engaged in effecting some of those improvements that have so much advanced the navigation of other rivers, and that you will not incur the risk of expending on works which may, and, as appears to us, must destroy the navigation of this river, a large portion of those funds which have been contributed for its preservation and improvement.

Without meaning to make any unkind personal reference, we would earnestly request that your determination on the present important question may be founded on the opinions of persons altogether unconnected with any private company, interested either in promoting or preventing the completion of the works, whether as shareholders, or employed by them.

We are sure you will the more readily adopt this suggestion when we tell you that it has gone abroad that many members of your Board are holders of shares in the intended railway company, or in ground which will be advanced in value by their operations, or are to be compensated out of its funds for loss of ground through which the railway is to pass.

We feel assured that, with you, Gentlemen, as with all men of honourable minds, the circumstance of being privately interested would but tend to a more scrupulous judgment against yourselves; but we thought it right to mention the report, as a knowledge of it will the more naturally lead you to make such a choice, in reference to those whom you shall consult, that the judgment to be come to shall not only be formed without bias, but received by the public with confidence.

Much has been urged in favour of the proposed work, because it is likely to give extensive employment to those wanting it. We do not underrate the value of public works in this particular, nor would we decline to bear our share of a burthen necessarily imposed for such a purpose; but, Gentlemen, we respectfully insist, that a well-designed public work will afford as much employment to those wanting it, as an ill-digested, or an injurious one, and the former will have the advantage. The public will be benefited by its producing the effects for which it was intended, and a new desire will be created for the accomplishment of other useful public works; whereas the misapplication of funds to objects for which they were not intended, still more to purposes at variance with them, however it may for a time, whilst the works are in progress, keep up the delusive appearance of public benefit, cannot fail, in the end, to produce dissatisfaction, and must act as a discouragement to future undertakings of a public nature.

We, therefore, respectfully request that you will be pleased to suspend any further prosecution of the proposed works until you shall have ascertained, by the opinion of some eminent engineers not engaged in any private speculation connected with them, and who shall have been heretofore engaged in the improvement of navigable rivers, how far these works may be injurious to the navigation, and how far the establishment of a railway upon them may interfere with future measures likely to be called for, by an increase of trade, or other circumstances; and in order to make available for this city the beneficial intentions of the Legislature, and, at the same time, to prevent funds provided solely for the preservation and improvement of the harbour from being diverted from their proper channels, we earnestly request that you will call upon the engineers who may be consulted, to report upon such works as may be best calculated to improve this river, consistently with the income provided for the purpose, and the known anxiety of the Government to promote such objects.

J. N. and J. MURPHY.
JAMES SCOTT and Co.
DANIEL SWEENEY.
BARRY, RING, and BURKE
THOMAS KIRBY.
DANIEL HEAGERTY.
GEORGE BICKERTON.
JOHN WRIGHT.
CHARLES JOHN.
JOHN M'AULIFFE.
JEREMIAH SULLIVAN.
THOMAS TOBIN, *Ballincollig*.
THOMAS COATES.
ROBERT LAWE.
WILLIAM H. HILL.

JOHN HARLEY.
AUSTIN HARLEY.
FRANCIS H. THOMPSON.
GEORGE LAURENCE, JUN.
THOMAS CLARKE.
WILLIAM BROWNE, JUN.
JAMES ROCHE.
CHARLES J. LEFEBURE.
HENRY BROWNE.
J. R. REED.
JOHN EDWARDS.
GEORGE WRIGHT.
MICHAEL WALLIS.
JAMES SEYMOUR.
JOHN TURNER.

CHARLES FLANAGAN.
BENJAMIN JOHNSON.
H. POLLOCK.
J. and B. CARROLL.
ROBERT SUTTON.
JOHN DAWSON.
WILLIAM LANE TOOKER.
JOHN KNIGHT.
CUMMINS BROTHERS and Co.
WILLIAM LAMBERT.
RICHARD WALLIS.
JOSEPH WHEELER.
JAMES WHEELER.
JOHN ROBERT BURKE.
JOHN KEAYS.

APPENDIX B.

CORK.

No. 70.
Todhunter, on the Proceedings of the Harbour Board.

No. 70.

Mr. W. TODHUNTER'S *Letters respecting the Proceedings of the Cork Harbour Board.*

Extract of a Letter addressed to Lord Eliot, dated 23rd October, 1842.

"It is not my intention to go into a detail of the subjects comprehended in the letters to which I have referred; but I hope I shall be excused for alluding especially to one of those Boards, (that of the Harbour Commissioners,) the objectionable mode of raising the funds necessary for the purposes of the Act, and the still more objectionable mode of carrying its objects into execution. They seem to be literally in the situation of the man who is said to have made a very ingenious mouse-trap, but could not tell how to set it; in like manner, this body has contrived a very complicated schedule of dues, but appear to be utterly unable to manage it; for it is not denied, I believe, that large sums of money are levied on the public in their name, which never reach the hands of their treasurer; and I would submit that some mode of raising the supplies should be adopted, not liable to the objections to which the present system is so notoriously subject. Suppose, for instance, on the tonnage of the ships arriving in the port, such a mode would not be open to fraud as the present is, and the impost would be easily and economically collected, and when known, would be no hardship on that interest, as freights would soon be regulated accordingly: many precedents may no doubt be obtained from the practice of other ports.

"To this I would only add, that all public Boards authorized to levy large sums of money on the public, ought, I think, to have their accounts subjected to the investigation of a board of public audit."

Extract from the Proceedings of the Harbour Board of 9th Feb., 1842, *as reported in the "Constitution" of the following day :—*

"Mr. Burke said, that it appeared to be the opinion of the Board, that the parties at present collecting the dues were very honest; but hundreds of hundreds of pounds were never paid into the Board. Which observation was followed up by Mr. Laurence, who said that he might make charges founded on very strong and just suspicion, but he would reserve himself until he had procured data."

RESPECTED FRIEND, *Cork, 20th of 7th Month,* 1844.

In endeavouring to draw the attention of the Lords of the Treasury to the subjects which form the object of this communication, I do so under a thorough conviction of the absolute necessity there is for the application of a remedy to the present state of things as regards one of our local public establishments, and I have thought that this may be the appropriate channel; if I am wrong in that respect, I trust I may be excused for the freedom I use, and that my motive may be appreciated.

On the 8th inst. I addressed a letter to the Secretary of the Harbour Commissioners of this port, a copy of which I forward herewith. Two Board days have passed since, and I do not learn that any notice has been taken of it, although he assured me that it should be laid before the Commissioners at their next meeting. As that letter speaks for itself, I shall not in this place refer to its contents, except the first paragraph, which alludes to a former correspondence and its unsatisfactory termination. The circumstance is, that I proposed to the Board to enable me to ascertain what return had been made to it of certain charges of which I complained, in order that I might see whether the full amount had been accounted for, under the apprehension that these charges were a source of considerable emolument to ship-agents, brokers, &c.; this was declined, hence the concluding observation.

The conduct of the affairs of this body exhibits the extraordinary and exceptionable circumstances of irresponsible collectors, excessive, unequal, and illegal exactions, improvident expenditure, and incurring debts and entering into obligations to a large amount for which the Act, under which they derive their authority, does not provide. Such results naturally follow each other, and as naturally flow from the circumstance of a body such as this not being subjected to the ordeal of an authoritative supervision of its accounts and proceedings. I could never understand why this body, as well as others established by Act of Parliament for local purposes here, should be exempt from the necessity of submitting its accounts to be audited, as well as that respectable body, the Ballast Office Corporation of Dublin.

In the year 1842, a notice appeared in our local papers of an intended application to Parliament for an Act for various local purposes; amongst others, for amending the Public Local Act of 1st Geo. IV., cap. 52, being the Act by which the present Board of Harbour Commissioners is established, and enlarging the powers of that body. On that occasion I addressed a letter to the Irish Government, an extract of which I send and in answer to it, received an assurance that Lord Eliot would attend to the suggestions when the proper time arrived; but the matter was not proceeded with, and therefore the contemplated opportunity never occurred.

The proceedings of the Harbour Board, at its weekly meeting on the 17th inst., throws a strong light on the subjects which I have proposed to submit to the consideration of the Lords of the Treasury; the facts disclosed in the statements of one of the Members of Parliament for the city appear to me especially important, and I therefore take the liberty of forwarding the number of the "Constitution" newspaper of the following day, in which the report of those proceedings appears.

I am, &c.,
WM. TODHUNTER.

Sir George Clerk, Bart.,
&c. &c. &c.

RESPECTED FRIEND, *Cork, 10th of 10th Month,* 1844.

With reference to the subject upon which I took the liberty of addressing thee on the 20th of 7th Month last, I again venture in the same way to solicit the attention of the Lords of the Treasury to the system pursued by the Harbour Commissioners of the port of Cork, as elicited in the two documents issued by them at different periods, sent herewith; upon which I propose to make some observations, which, I think, will establish the truth of several of the allegations contained in my said letter.

The first document I shall refer to is the schedule of "Harbour Dues," published in 1842; and I may remark that, although it bears that date, it is but a reprint of a former one, without any alteration, that I am aware of, except the note relating to the dues on deals and planks. I shall not go into any lengthened observations on this schedule, but merely refer to two or three items in it, which show, I think, the unfitness of those who undertook to compile it for the office. Under the head Groceries, the article currants affords a singular proof of this: a carotel is subject to a payment of 9*d.*, whilst a butt, which contains more than double the quantity, is only charged 8*d.* Under that of Wood, pine timber is subject to 4*d.* per load, whilst deals, composed of the same material in a more advanced state of preparation for use, is not chargeable with half that amount; for the average dimensions imported would not amount to 2*d.* per load, at the rate of 1*s.* for 120; and the modern introduction of the note to which I have referred, I consider a great aggravation of the original fault. I cannot explain myself better on this subject than by the following example :—

	s.	*d.*
120 deals, 10 feet long, 9 inches broad, and 2 inches thick, contain 3 loads at 2*d.*	0	6
120 planks, 40 „ 12 „ 3 „ 24 „	4	0

Thus it is the interest of the importer to enter small deals by measure, and large ones by count. It may also be seen that a bag, *bundle*, or hamper, is chargeable with 2*d.*; whilst a *parcel*, if ever so small, is liable to 3*d.* As a practical illustration of this matter, I may mention what fell under my own observation. A small parcel, weighing only 13 ounces, which came from Dublin by a steamer, was charged 3*d.* by the agent; and this was a direct violation of the Harbour Act, which limits the import to one-eighth of the freight which the article may be liable to, which in this case was 1*s.* These absurdities, if such they are entitled to be called, appeared on the former schedules as they do on the one recently published.

It is, I apprehend, within the knowledge of their Lordships, that this Board has incurred a large debt by the extension of what is known here by the name of the Navigation Wall. For this, it appears, they issued to the contractor what at the time were called debentures; but it being alleged that the Act by which they are embodied does not authorize any such transaction, the form of the obligation was changed. These instruments got into the market, and in consequence of the light which has been lately thrown on the subject, some of the holders became dissatisfied, and the debt has become troublesome, and it was found necessary to raise additional funds to meet the exigency, and a revision of the schedule of dues, in order to increase the rate of the impost, was agreed on; and the revised schedule, which constitutes the second document to which it is my object to call the attention of their lordships, is the result. Amongst the influential members of this Board are persons largely engaged in the importation of dried fish, of articles for tanners' use, several timber-merchants, and others very extensively engaged in the sale of manufactured goods of almost every description—woollen, cotton, silk, linen, haberdashery, hats, &c. The individual chiefly engaged in the revision is of the latter class, and it so happens that not one of the articles embraced by the business of those parties, with one exception, which will effect a small reduction, has been touched by the revised schedule: but although these have been neglected, nothing connected with agriculture appears to have been forgotten. In proof of this, I need but refer to the first item of the schedule, and then to the important article of guano; and it would be difficult, I think, to assign any satisfactory reason why it should be subjected to a charge for the purposes of this establishment *five times* the amount of that imposed on dried fish, bark, valonia, &c.; or why a body such as this should be invested with authority, capable of abuse where their own interests are concerned, to tax the property of others, restricted only in this respect, that the dues shall not exceed one-eighth the amount of freight to which goods shall be subject; or what necessary connexion there is between the distance which an article of merchandise comes, and consequently the rate of freight it is subject to, and the value of the accommodation afforded by the port of Cork. Yet such is the law. It appears to me, however, time to relieve persons so circumstanced from the invidious task of providing funds to meet pressing wants, which may expose them to the ungracious imputation of being unwilling to participate in the burdens which they impose upon their neighbours.

A reference to these schedules will show how difficult it must be to manage them so as to avoid the risk of extortion on the one hand and peculation on the other, the money passing through the hands of brokers, ship-agents, &c., and the schedules themselves being of so miscellaneous a character. It may be observed, that I have marked on the margin of that of 1842 the articles affected by the recent revision, and on the new one those which have now for the first time been introduced into the class of enumerated articles, and that the revision does not extend beyond imports.

Since my former letter, I have met with a memorandum which I made on the occasion of the statement of the Harbour-master therein referred to, probably about two years since, which appears so intimately connected with the subject of this communication, that I take the liberty of copying it here:—"Since publicity has been given to their proceedings, the Harbour Commissioners appear to have been a good deal occupied with recriminations as to the part taken by different members of the Board with respect to the extension of the Navigation Wall, and discussions as to the propriety of either pulling it down, continuing it according to the original plan, or terminating by an embankment carried across to the main land, with or without a sluice, as certain persons possessing property there insist on the preservation of their right to a water communication therewith. In fact, the only thing they appear to be agreed about is, that the wall in its present state is a great nuisance, and a source of continual expense, as it promotes the accumulation of sand and mud to the great injury of the channel, which renders it necessary to employ the dredge-boats to clear it away, and which, being thrown at the back of the wall, the tide as constantly washes into the channel again, below its termination. It has, however, been alleged that this wall may be advantageously used for tracking ships along the river, but that point has been pretty much set at rest by the fact which was recently elicited at one of the meetings of the Commissioners from the Harbour-master, that the foundation of the wall is not laid as low as the channel of the river by four feet, so that they cannot approach it by a considerable distance to clear away the bank, in order to afford sufficient water for ships to be tracked along it; and it is, therefore, nearly useless for that purpose, and this is an irremediable defect as regards the present wall. But there appears no reason to doubt that this wall was undertaken for the promotion of objects quite foreign to the purposes for which the Harbour Commissioners are authorized to levy taxes on the commerce of the port. One of these objects was the lately projected railway between Cork and Passage, which was to have been carried parallel to it at a short distance upon the reclaimed land; this bubble has, however, burst. The other was the formation of a park of about 300 acres, for the amusement and recreation of the citizens; but there were found to be two objections to this scheme—the one the alleged interference with the rights of the occupants of property on the south shore, as to water communication, and the other the trifling circumstance that the land, if reclaimed, would be the property of somebody else."

I am, &c.,
WM. TODHUNTER.

Sir George Clerk,
&c. &c.

Appendix B.

Cork.

No. 70.

Todhunter, on the Proceedings of the Harbour Board.

Extract of a Letter from Mr. Wm. Todhunter *addressed to the Secretary of the Treasury.*

Sir, *Cork*, *26th of* 10*th Month*, 1844.

* * * * I allude to the land in this harbour usually known as the Slab, a part of which has recently been reclaimed from the overflowing of the tide, and a further portion of which is at present contemplated. The right to this land is, I have no doubt, vested in the Crown, and the object of my present communication is to suggest the appropriation of it, or at least a portion of it, to a matter of great national importance.

There appears a strong probability that a railway will ere long be constructed communicating with the city of Cork; and my purpose is to point out what appears to me calculated to facilitate the intercourse between the south of England and the southern and western parts of Ireland, by means of such appropriation, beyond any plan which has fallen under my notice.

I understand the Ordnance Survey of the city and neighbourhood of Cork has been engraved, but I have not heard that any copy of it has reached this county. Of course, I have not seen it; but as it is thus within the power of their Lordships, and assuming its perfect correctness, as well as the minuteness of its details, I shall proceed to explain myself as if it were before me, as I presume it to exist. In doing so, I shall begin by directing attention to the place, to the westward of the city, a little above Wellington Bridge, where the River Lee divides into two branches, distinguished by the names of the North and South Channels, formerly defining the proper boundaries of the city on those two sides. A glance at the map must show that the North Channel is the principal one. I then wish to point to the course of that channel at the eastern side of the city, nearly opposite to the Custom-house, and it will be seen that the Quay wall, opposite to the Steam-packet Station, ranges nearly in a direct line to the castle of Blackrock, through the whole length of the land already reclaimed, as well as that which is projected. This course, it must be obvious, was the natural one for the main channel of the river, and there is no doubt it was originally the case, as traces of it still exist. A reference to the map will at once show the advantages for the purposes of navigation, which such a course would possess over the circuitous one of the present channel. I shall now proceed to describe the portion of the Slab already dried, and for that purpose direct attention to the present channel, opposite to a place called Myrtle-hill Terrace. It may be observed that there are, in the Navigation Wall at this place, two angles: about sixty yards to the eastward of the lower or receding one, where the recent extension of the wall commences, the embankment which encloses the reclaimed part of the Slab also begins, and is carried in a N.E. direction till it reaches nearly to a place called Cleve Hill, when it turns up parallel to the shore as far as Sans Souci, for the purpose of reserving a water communication to the residences in that space; but the proposed reclamation, if carried into effect, will embrace the whole of the Slab as far as the end of the Navigation Wall, by a permanent stone wall carried across fromthence to a lane to the eastward of Clifton. This Slab being dried, affords the opportunity of adopting the most economical mode of excavating what may be necessary to form a direct channel, either by manual labour or by letting in the water, using steam dredges. I now turn to the existing channel, below the Steam-packet Station, for the purpose of showing that by adopting the plan I have taken the liberty to suggest, a very important result would be obtained by the acquisition of a floating basin of very considerable extent, and at a very small expense, where ships may lie water-borne at all times, formed at the upper end by continuing the wall across below the steam-packet station, as indicated by the present Quay Wall there, with gates for the admission of ships, and closing it at such place to the eastward as may be thought expedient; suppose, for instance, opposite to Myrtle-hill Terrace. This plan suggests the propriety of the terminus of whatever railway may be conveyed into Cork, for the purpose of communicating with the interior of the country, should be here for the object of promoting economy, both of time and money, in the transit of the produce of the country, as well as the receipt of merchandize for internal consumption; and the advantages which the port of Cork presents for facilitating these objects, its safety, capaciousness, and its accessibility at all times of tide, are too well known to render it necessary to dilate on: but, considered with reference to its proximity to the Atlantic Ocean, its position with respect to both the English and the Bristol Channels, and in the present improved state of steam navigation within twenty-two hours of Liverpool, Cork presents combined advantages for both external and internal communication, with which, I apprehend, no port in the south of Ireland can compare.

C. E. Trevelyan, Esq.,
&c. &c.

I am, &c.,
Wm. Todhunter.

Henry Hardy, Esq. (Copy.) *8th of 7th Month*, 1845.

Some time since, several communications took place between us respecting overcharges made in the name of the Harbour Commissioners in harbour dues on goods coastways, which I acknowledge terminated very unsatisfactorily.

It is not, however, my object to revive the controversy on the matters embraced by that correspondence; but I have seen by the Report of the proceedings of the Board last week, that a case is about to be submitted to counsel, relative to tonnage duties on ships trading between Great Britain and Ireland, and I beg to suggest that the inquiry may be extended at the same time to the question of the *legality* of the charge of harbour dues on coasting trade.

By the Act by which the present establishment is constituted, the Harbour Commissioners are only authorized to levy dues on goods exported from and imported into the port of Cork; and as the transit of goods coastways is not, I apprehend, either exportation or importation, in the legal sense of those terms, if I am right, (and I believe the subject does not admit of a doubt,) it follows, that this exaction has been always and altogether illegal.

I have no intention of anticipating what may be the result of the question raised respecting the tonnage duties; but should the correctness of the views under which it has been brought forward be established, the consequence must, I believe, be, that the collection of the harbour dues on merchandize will not be a very laborious duty.

I am, &c.,
Wm. Todhunter.

No. 71.

Complaint of the Cork Steam Ship Company.

No. 71.
Complaint of the Cork Steam Ship Company.

SIR, *Cork, 30th January*, 1846.

In reference to a list of queries put by the Tidal Harbours Commissioners, and particularly as regards Nos. 55, 74, 75, and 121, I most respectfully beg, on behalf of the Directors of this Company, to impress upon them that the steam vessels which ply out of this port, and perform its principal coasting trade, have not that accommodation in quays, berths, water, &c., which could be afforded, and which their safety, and consequently that of the passengers and crews, and the property vested in and conveyed by them, demands.

These vessels, when practicable, should always be water-borne, and where such is impracticable, should be most judiciously placed with reference to their dimensions, and build, and always in a berth, to be occupied by steamers of the same dimensions; as from their weight of machinery they may strain in taking the ground, even with the best care and attention. Nevertheless, in Cork they have not only to take the ground, but under most disadvantageous circumstances, for (without regard to the great necessity of keeping the same berth for vessels of similar build, &c.) small sailing vessels are allowed to take possession immediately after the steamer vacates, and so to alter the formation of the berth that the next steamer occupying it will inevitably strain, and when she again goes to sea will possibly endanger the lives of all on board.

I send herewith a sketch of that part of the quays where the steamers lie, by which it will be seen that in the middle of the channel there is from 6 to 7 feet depth at low-water spring tides, and that the foundations of the quays could be so deepened to the extent of the red line on the sketch, as to give nearly 7 feet alongside, and keep the vessels nearly always water-borne; and to the extent of the dotted line, where there is a width of nearly 400 feet, they could be so piled outside, as in Dublin, as to give the same depth; and also, what is most desirable, additional quay-room, without interfering with the navigation of the river.

Many of the Harbour Commissioners of this port, however, who are elected out of the corporation being, uninterested in and ignorant of maritime matters, cannot see the necessity for granting the before mentioned accommodation, or any part of it, although it has been urgently required of them from time to time; and our directors are therefore compelled to conclude, that unless a general superintending power be instituted, under which the local body must act, the steam interests of this port, and consequently the port itself, will ultimately suffer most materially.

Trusting that it may accord with the views of the Tidal Commissioners to recommend such a power, and that it may shortly be brought into effective operation,

I remain, &c.,
L. W. GLOVER, Secretary.

To the Secretary of the Tidal Harbours Commission.

No. 72.

The Memorial of the undersigned landed Proprietors, Inhabitants, &c., of the town and neighbourhood of Midleton and Ballinacurra,

No. 72.
Memorial of the Landed Proprietors, Inhabitants, &c., of Midleton and Ballinacurra.

6th March, 1846.

Respectfully showeth,—That the harbour at Ballinacurra is situate at the eastern estuary of the Cork Harbour, distant from the city of Cork upwards of 20 miles by water, and having no common interest therewith.

That the tolls collected on vessels loaded and discharged at Ballinacurra and Midleton, since the establishment of the Harbour Board in 1820, amount to a sum of 10,000*l.* and upwards, and that no part thereof has been expended in the improvement of the harbour of Ballinacurra, which has been permitted to remain in a neglected state (though capable of great improvement), to the great injury of this town and neighbourhood.

That the funds heretofore raised on the harbour of Ballinacurra and Midleton have been expended by the Harbour Board (acting under the Act 1 Geo. IV. cap. 52) in the improvement of the river and quays of the city of Cork,—a manifest injustice to the inhabitants of this town and neighbourhood, who have no interest therein.

That it would greatly benefit this town and neighbourhood, and also a populous and extensive district of which the port of Ballinacurra is the natural place of import and export, that a local body should be legally established with power to manage the said harbour, and to raise and apply the tolls thereof in its improvement.

May it therefore please your Honourable Board to recommend to Parliament such legislative enactment, as would secure to the inhabitants of this town and neighbourhood the control of the dues collected at this port, in order to the due expenditure thereof in its improvement.

And your memorialists will pray.

(Signed) G. B. ROCHE, M.P.
SHANNON.
MIDLETON.
[And 97 other signatures.]

To the Tidal Harbour Commissioners.

No. 73.

Captain WOLFE, R. N., *on the want of Lights, Buoys, and Beacons on the Coast of Ireland.*

No. 73.
Captain Wolfe, on the want of Lights, Buoys, and Beacons on the Coast of Ireland.

SIR, *H. M. S. Tartarus, Cork, 10th March*, 1846.

My frequent passages between Cork and the Shannon, during a period of eleven years that I have been employed in charge of a survey in Ireland under the Admiralty, have suggested to me some remarks respecting the light-houses on that coast, which I beg to lay before you.

First, as regards the great want of a light on the Foze Rock, the most western point of Ireland, which forms a salient angle extending eight miles beyond the direct line between the Loop Head and the Skelligs. The want of this is much felt by the Limerick traders, who having lost sight of the Loop Head Light, have no means of ensuring their being far enough to the westward to bear up to make the Skelligs. The distance between the Loop Head and the Foze Rock is 40 miles, and from the Foze to the Skelligs 16 miles, giving a distance of 56 miles, without any light on a coast which is the general landfall of all vessels coming from America.

The coast between the Skelligs and Cape Clear lies under similar disadvantage, where we have nearly the same distance without a light, and a projecting danger in the Bull Rock off Dursey Island.

I would therefore suggest the necessity of lights on the Foze and Bull Rocks, even, if absolutely necessary, at the sacrifice of that on the Skelligs, as at this point both the above lights would be visible. But as the means of distinction of lights is great by their being doubled, fixed, or revolving at different intervals, colour being a very unsatisfactory method of distinction, as haze will give a lurid appearance to a bright light, the Skelligs might still be retained.

Next, I would suggest the advantage of removing the present light on Cape Clear to the Fastnet Rock, where it would be visible soon after leaving the Bull, instead of being shut in as it now is by Mizen Head

APPENDIX B.

CORK.

No. 73.

Captain Wolfe, on the want of Lights, Buoys, and Beacons, on the Coast of Ireland.

Again, the distance between the Fastnet and the Old Head of Kinsale being above 45 miles, a light on the Galley Head is very desirable, as the practice of the transatlantic steamers of making the coast of Ireland and running along its shores, both outward and homeward bound, renders it necessary that they should be well lighted.

The want of a light between the Old Head and the Hook of Waterford is a source of constant complaint, on account of the great trade from Liverpool and the Bristol Channel to Cork.

The disadvantage of placing light-houses on very elevated positions is now, I believe, generally admitted on account of their being so often obscured by fogs, and I have in the *Tartarus* passed both Cape Clear and the Old Head, seeing the break on the shore even by night, without the light being visible.

Some distinguishing day marks are also much wanted on this coast; many of the headlands make so precisely alike, that unless you can see a long line of coast, it is often extremely difficult to know one from another. It would, I think, be advisable to have either a white-washed, or in some cases where to be seen against the sky, a striped black and white wall, which might be varied in height and length for distinction; round and square towers also might be used, or any other simple means for enabling the mariner in hazy weather to make sure of his land fall.

This range of coast possesses many harbours, though with the exception of Cork, Berehaven, and the Shannon, only adapted for vessels of moderate draught of water; they are more especially available for steamers, I am in the habit of passing in and out of the harbour of Courtmacsherry in the *Tartarus*, over a bar with 11 feet at low water springs, and although but small, it is capable of great improvement, and had it been better known, many a life and vessel might have been saved in this dangerous bay. No superintendence or control is exercised over any of them, except at Cork and the Shannon, and the necessity of it is obvious, for at Bantry vessels are accustomed to throw over their ballast into the harbour; and at Courtmacsherry it is now proposed to run a causeway across the harbour, for the sake of a nearer communication with Bandon, which unless judiciously executed, may prove the ruin of the harbour.

Berehaven, through your instrumentality, has been buoyed sufficiently for the use of large ships by the Admiralty, but were it a place of more resort, it would require more beacons for trading vessels. Valencia and Baltimore have each one beacon, but with these exceptions, there is not a buoy or beacon in any one of the harbours. The most surprising neglect, however, is presented in the Shannon, under a special board of Commissioners; not one buoy, and but one beacon exists throughout the extent of about 60 miles from Limerick to the Loop Head, the upper part of which is very intricate and dangerous. The buoy belonging to Beal Bar lies on shore at Carrigaholt, and I have seen the iron buoy which marked the northern point of the Scartlet's Rocks lying dry at low water, with its chain attached to it, and wanting merely to be staunched to cause it to float again.

Even the splendid harbour of Cork is indebted to Government for all the buoys below Passage, with the exception of two; and one of these, at the tail of the Spit from Haulbowline, should be replaced by a small vessel of 20 to 30 tons, showing a bright red light, which would serve not only for steamers running at night, but also be a mark for the usual anchorage in the outer roads.

I have, &c.,

Captain Beaufort, R. N., F. R. S., Hydrographer. JAMES WOLFE, *Commander and Surveyor.*

No. 74.

Captain Evans's Report on Bantry Harbour.

No. 74.

Report of Captain EVANS, R N., *on Bantry Harbour*—1835.

BANTRY Harbour, and from Blue Hill down between Whiddy, Chapel, Rabbit, and Horn islands, consists of muddy bottom, good holding ground, and from four to six fathoms regular soundings, well sheltered from every wind and sea. The bay from Bantry Harbour to Berehaven is clear of danger, and may, with the assistance of the chart, be used by strangers.

Castletown Harbour, in Berehaven, is a very good one for small vessels drawing about 10 feet water. Such vessels may enter at all times of tide, the rise and fall being in ordinary spring tides about 12 feet. This harbour would contain a number of small vessels secure from all winds.

The western entrance to Berehaven is confined, being about 200 fathoms across the narrowest part, but it widens immediately both inside and outside.

The tide does not set very strong through this entrance, seldom exceeding two knots, except after heavy rains.

In coming in the western entrance, the starboard, or Bere Island shore must be kept on board, as there are several rocks called the Colts, on the larboard side near the mainland. These rocks might be easily buoyed off, and are not in the channel.

I see no difficulty in any vessel taking this entrance with a leading wind.

I found deep water all over Berehaven, varying from 15 to 6 fathoms, fine holding ground, and well sheltered both from wind and sea.

The eastern entrance to Berehaven is a very good one, and if a ship could not get to sea from the western entrance, she could always get out of the eastern as long as she could carry canvas.

The Dog Rocks, which are covered only at high water, and generally show by the sea breaking on them, lie about two cables' length off the east end of Bere Island, and must be left on the larboard hand going in. The passage between those rocks and the island is very narrow, and not to be attempted by strangers. The eastern entrance to Berehaven lies between the Dog Rocks and the Sea Islands, or, as the natives call them, the Roan Corrigs.

The entrance is very deep, having 19 fathoms all the way across it, and is of sufficient breadth for any vessel to beat in against a head wind. The passage between the Seal Islands is also good and deep, as well as the passage between the North Seal Island and the main land. E.N.E. true bearing, and about three-fourths of a mile from the south or Great Seal Islands lies the Ducallagh Rock, which only appears at low-water spring tides. This rock should have a buoy placed on it to guide vessels going up to Bantry; and the Dog Rocks should either be buoyed off, or a small lighthouse built on the outer or larger one, which would render the eastern entrance available, day or night, with perfect safety.

By these few necessary works of trifling expense, Berehaven would be made as fine and safe a harbour as could be desired.

Should a vessel, in attempting to beat out of Bantry Bay during a westerly gale, carry away any of her spars, or get disabled, so as not to fetch back into Berehaven, she might then bear up and run either for Glengariff or Whiddy Island, where there is good and safe anchorage for any class of vessels. Bere Island is remarkably well calculated for either a naval or military depôt; and Lawrence's Cove is formed by nature for a naval arsenal; docks to any extent might be constructed there at a very moderate expense, and vessels may be hove down close alongside the shore, in perfectly smooth water, in all weather; the rocky beach forming a natural quay.

Bere Island is a healthy situation, producing plenty of vegetables, abounding in fresh-water springs, and fish is plentiful and cheap.

Were Berehaven made a naval and military depôt, the communication between it and the town of Bantry would be carried on by steam vessels. This would obviate the circuitous route by land (28

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CORK.

No. 74.

Evans's Report on Bantry Harbour.

Irish miles) between these places, and connect Berehaven with a place to which, perhaps, a railroad might be constructed, either from Cork or Dublin.

Depôts of troops, stationed at Berehaven, would be in the best possible situation in the United Kingdom for embarkation to the colonies; whilst a great facility for removing them to or from any part of Ireland that might require their presence, would be afforded by making Bantry the termination of the contemplated railroad from Dublin.

I need scarcely add that provisions could be obtained at a more moderate rate than in England, and that there would be little difficulty in obtaining plenty of men both for the army and navy.

Could a railroad be made from Dublin to Bantry, Berehaven would possess every advantage necessary for a packet station—namely, facility of egress and ingress, in all weather that a ship could keep the sea; a good harbour under the lee, if beating out; plenty of sea-room when once well outside the bay, and, owing to the prevailing winds being from the south-west and west, a vessel leaving Berehaven would command the coasts of Spain, Portugal, and the Mediterranean, as well as be in the most desirable spot of departure for either the West Indies or America.

A convincing proof of this occurred whilst I was at Berehaven. Several vessels having put in there during a very heavy gale from the southward, the moment the gale abated they went to sea. On my way to Berehaven, I left transports, with troops on board, wind-bound at Cork; and, on my return from Berehaven, those vessels were still lying at Cork, not having been able to get out. Had these troops been at Berehaven, they would have been far advanced on their voyage to the West Indies before they were able to leave Cork.

No. 75.

VALENCIA.

No. 75.

Evans's Report on the Harbour.

Report of Captain EVANS, R.N., *on Valencia Harbour*—1835.

I found Mr. Nimmo's chart of Valencia very correct. The river Carhin, as far as Cahirciveen, is navigable at high water for vessels drawing from 10 to 12 feet. There is a good anchorage for that class of vessels off Tohill Island.

The Lough Kay channel is the best for vessels going up the river, as they will avoid the bar between the Ferryhouse and Church Island. It may also be very useful to any vessel that might miss the north-west entrance.

The north-west entrance into the harbour of Valencia, between Cromwell's Fort and Beg Innis, is very narrow, being only a cable's length: but it is safe, and when once inside, good anchorage sheltered from every wind will be found up to the Foot Point, with from six to seven fathoms water.

Care must be taken in rounding Cromwell's Fort Point, as the rocks lie out some distance to the northward. The harbour's mouth ought to be well open before running in, which makes it more difficult for sailing vessels.

About a quarter of a mile inside the north-west entrance lies the harbour rock, in mid-channel; it dries at the last quarter of ebb. This rock would require a lighthouse on it, and would serve to point out the entrance, day or night, in coming from sea.

From the confinement of the north-west entrance to Valencia Harbour, I do not think it could ever be made available for sailing packets; although were very powerful steamers, such as must necessarily be employed to cross the Atlantic, occasionally to assist in towing the packets in and out, much might be effected.

The western channel from Valencia to the Atlantic is very narrow for about a mile; it has only seven feet water in some places at low-water spring tides, and the entrance, which is only two cables' length wide, is exposed to a heavy sea when it blows from W.N.W. round to S.S.W.

This entrance to Valencia could only be available for steam packets, and their station must be below Fort Magee, just inside the entrance, where there is good anchorage for a few vessels in four fathoms water. When the westerly gales set in, the steam packets might run round at high water, and go to sea by the north-west entrance.

A sailing packet, on leaving the north-west entrance during a westerly gale, would have to beat dead to windward against a heavy sea, to clear Valencia island to the southward, or the Blaskets to the northward, and should any accident happen, there is no harbour under her lee.

No sailing packet could leave either entrance to Valentia with the wind blowing hard from N.N.W. to W.N.W.

Steamers alone could in such cases be available as packets. They could always go out whenever they could make any progress, either to America or the West Indies, by being outside.

The same remarks would also apply to the sailing packets; for when they could not beat up, so as to weather the Blaskets or Valencia, they could not make any progress on a western voyage, and might as well be in the harbour; but many cases might occur, where a steamer could get out and proceed without being able to tow a sailing packet out of either entrances of Valencia Harbour, as the steamer would find it hard work to get out alone.

Taking everything into consideration, it is my opinion that Valencia might, by erecting proper lighthouses, be made available as a steam-packet station, but not as a sailing-packet station, when the packet must go out in all weathers.

These remarks do not, of course, apply to merchant vessels, as they can always suit their sailing to the weather.

Valencia Harbour offers, independent of its excellent anchorage, one of the best places for a pier or landing place imaginable. It is at the Foot Point, where a spit of sand runs, which dries at low water, and has at its extremity, only a few yards distant from where it dries, six fathoms; the end of the spit being nearly perpendicular.

APPENDIX B.

LIMERICK.

No. 76.

Evidence taken on the 18th Sept., 1845.

No. 76.

PORT OF LIMERICK.—*River Shannon.*

Examining Commissioner—Capt. WASHINGTON, R.N., F.R.S.

Present:—The Earl of LIMERICK, the MAYOR, Lieut.-General Sir RICH. BOURKE, AUGUSTUS S. O'BRIEN, M.P., CALEB POWELL, M.P., SAMUEL DICKSON, WILLIAM ROCHE, JOHN WATSON MAHONY, Collector REAVE, WILLIAM HOWLY, Capt. TULLY, D. S BROCKETT, R. RUSSELL, JOHN VANDERKISTE, THOMAS ROCHE, R. HARVEY, WILLIAM H. OWEN, WM. RANDALL, JAS. BANNATYNE, Rev. WM. WALLER, ROBERT RONGER, JOHN SHARPE, JOHN MULLOCK, F. J. O'NEILL, MARCUS KEAN, &c.

[*The Admiralty Chart of the Shannon, by Captain Wolfe, R.N., on the scale of 4½ inches to a nautic mile, was laid on the table.*]

Mr. W. ROCHE read letters from Lord Devon and Sir Lucius O'Brien, the latter stating that he was unable to attend owing to railway business, and hoping that the dangerous state of the neglected river Fergus would not be lost sight of by the Commission.

Mr. REAVE, Collector of Customs, said he had furnished the Commissioners with a schedule, setting forth the gradual progressive increase of the revenues of the port. Notwithstanding all the disadvantages experienced, and the existing impediments to navigation, for the last 20 years the custom duties had increased from 58,000*l.* to 170,000*l.* per annum. The shipping in '25 was 563 tons, in 1845 it is 14,086 tons.

Mr. JOHN ROCHE, Secretary to the Bridge Commissioners, examined. He produced the different harbour books in his possession, with the Act of Parliament under which the board of Bridge Commissioners was constituted. The accounts are not audited by this board; the Commissioners are merely the medium through which the harbour business is transacted; the Board of Works have a mortgage on the property, and this board has no power to expend a penny without their sanction. The annual receipts and expenditure average from 4,000*l.* to 5,000*l.* The shipping interest of the port has no control over the expenditure, except that they constitute a portion of this board, and recommend the necessary expenditure. There are 72 commissioners; 42 are for life, and 15 are biennially elected by the rate-payers of the port. At present there are 12 ship-owners out of the 15. A committee of the commissioners, denominated "the Pilot Committee," look after the port. Captains MUDGE and WOLFE have reported on the improvements necessary for the river Shannon. The Commissioners have no funds to improve the port, further than to keep the quays and docks in a proper state of repair.

Mr. WILLIAM CARROLL.—I am secretary to the Chamber of Commerce since 1836, and receiver of harbour duties since 1844. I have made out a return, showing the progressive increase of the income of the port for every five years, from 1826 to 1845. For the first five years the income was 7,508*l*; the second five years, 8,527*l.*, being an increase of 1,019*l.*; the third five years, 14,464*l.*, being an increase of 5,596*l.*; the fourth five years, 18,727*l.*, being an increase of 4,263*l.* The separate duties on shipping alone entering the port for the year 1844, was 1842*l.* The number of vessels, and the average tonnage, for the last 20 years, were in 1824, vessels 367, tonnage 30,313; in 1829, 427, tonnage 50,199; in 1834, 453, tonnage 61,930; in 1839, 532, tonnage 61,970; in 1844, 508, tonnage 66,613. Last year we had 60 foreign vessels, including 38 from America. This year we had several foreign ships, with sugar and other commodities. The size of vessels trading to the port has increased considerably. Frequent complaints have been made of the impediments in the river, and obstruction to the navigation. The unimproved state of the port has been a subject of general complaint among mercantile men, and the existing grievances have been frequently set forth by petitions to Parliament and memorials to Government. The mercantile interests conceive the Bridge Commissioners have nothing to do with it, for they know they have no funds. The average amount annually levied on shipping is about 2,000*l.* Copies of the memorials forwarded to Government are entered on the minutes of the Chamber of Commerce. The cause of complaint is decidedly the want of docks, and of the removal of obstructions down the river.

Mr. F. J. O'NEILL.—In this city the Commissioners merely act ministerially, as everything they do must be ratified by the Board of Works. We have frequently represented our grievances, and pointed out the necessary improvements, but to no effect, the property of the port being mortgaged for advances made to build the Wellesley Bridge, at a time when we were given to understand the floating docks would be constructed.

Mr. WILLIAM RANDALL, harbour master, examined. From the year '21 to '26, he was trading to this port as master of a vessel; he subsequently became a resident ship-broker and in '34 was elected a Bridge Commissioner, which he held until his appointment as Harbour Master in 1844. During the time he was in office he acted as a member of the Pilot committee, to whom the management of the port was entrusted, and who directed the then Harbour Master in the discharge of his duties. All the difficulties and impediments to navigation on the lower Shannon, which existed in 1821, still continue. Since the passing of the Act, under which this board is constituted, 65,000*l.* has been levied by tolls, still no improvement has been effected, but great accommodation has been afforded by the construction of the new line of quays, which cost 18,000*l.* Up to 1834, under the old Act, 21,200*l.* had been received for the improvement of the port, and not a penny had been expended on it. All the money intended to be appropriated towards erecting the floating docks, had been expended in building a bridge, with a basin, or dock capable only of holding four vessels and a half—four and a turf-boat.

The MAYOR said the great misfortune was that the word "Docks" did not precede "Bridge" in the Act of Parliament, for if it had the docks would have been first erected.

WITNESS.—The erection of the bridge cost 85,000*l.* Before the bridge was built the port extended further up the river; I often sailed myself from the Custom House, 400 yards above the bridge. Thomond Bridge, above the mills, was taken down and rebuilt by the corporation, at a cost of 9,000*l.* The erection of the Wellesley Bridge has so far damaged the port, the sanction of the shipping interest was obtained before it was erected. The Chamber of Commerce sanctioned it,

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because they were led to believe that a floating dock to accommodate sharp vessels would be constructed, but it never was done. The height of the mill-weir above the bed of the river is six feet. There is another weir above that—the Lax Weir; the tide flows as far as St. Thomas's Island, about a mile and a quarter from the Wellesley Bridge, and above the salmon weir. Those weirs are an obstruction to the tidal water; but if removed, the rise in the bed of the river would not allow the tide to flow much further up. The bottom of the river is all limestone; and vessels, when in port, lie upon rocks; and considerable damage arises, particularly when laden. Damage is done yearly in consequence of the unprotected state of the port, as vessels are exposed to the prevalence and severity of westerly winds; in '39, damage to the amount of 5,000*l*. was done to the shipping by a furious gale of wind, which drove four of them against the Wellesley Bridge, and knocked some of it down. When it blows fresh up, I would sooner ride in a gale at Yarmouth or the Downs, than in the port of Limerick. If the bridge had not been there in 1839, so much damage would not have been done; for if driven up on the Strand, there would have been a better chance. Vessels pass up the river to the Custom House and Honan's Quay, through the swivel bridge and dock. There is no additional charge for passing the bridge.

Collector **REAVE**.—Vessels do not lie safely at the Custom House. I have known instances where vessels were damaged from lying on the ground, which occasioned a large sum to be expended by the owners in repairs.

HARBOUR MASTER.—At high-water the average level below the top of the quay is three feet; but he often knew a spring-tide to flow over the quays. Complaints have been made of this frequently to this board, who have represented it, but to no purpose. No fenders placed along the quays to protect vessels from damage in such cases, as in every other port. Was of opinion that Kilrush pier ought to run two points more to the southward. It was erected by the Shannon Commissioners, who never consult this board on anything. Cannot tell the object of building Kildysart pier; vessels cannot venture to lie alongside it; nor was there now any road to it. Piers were erected at Loughill and Kilteely by the Shannon Commissioners, but had a pier been built at Glin, it would have been far more advantageous and useful.

Mr. **DICKSON** said that in the expenditure of the Shannon Commissioners, everything was done by interest to improve private property, and to gratify landed proprietors, by erecting piers leading to their residences or on their properties.

Mr. **RANDALL**.—There is a great want of buoys and leading marks along the river. We have Capt. Wolfe's Government survey, shewing the want of improvement, but nothing was done in consequence. A few hundred pounds would beacon and buoy the river, and the Bridge Commissioners applied several times for it to the Board of Works; the answer was, "there are no funds; your income is not able to pay the interest of the money advanced." The Chamber of Commerce did buoy the river, but these marks have been worn out, sunk, or destroyed: and since the management of the port was transferred to the Board of Works, and the Bridge Commissioners, the buoys and beacons have been neglected.

The **MAYOR** said frequent applications had been made to the Board of Works, to induce them to repair a guard wall at the North Strand side of the river, which is in a dangerous state, and the answer always given was, "there are no funds."

COMMISSIONER.—From all he had heard, the Bridge Commissioners and Chamber of Commerce seemed to have done everything in their power, and therefore the blame was removed from their doors.

Mr. **RANDALL**.—The remedy he would recommend for the improvement of the port is the construction of a floating dock below Meade's quay, on the south side, capable of containing 50 large ships, and clearing all obstructions in the river. Had these improvements been made 20 years ago it would most decidedly have increased the trade of the port; for, notwithstanding all the disadvantages that exist, the trade has increased in an equal proportion to any other port in the kingdom, several large ship-owners were prevented from getting more extensively into the trade, owing to the state of the harbour. As a harbour-master, and having the arrangement of the bridge and docks, most certainly would have erected the floating-dock first. In addition to the improvements he recommended, the port ought to be cleared as far as Beagh Castle, and the Heron Rock, the Slate Rock, and the Cock Rock ought to be blasted. A tide gauge as a register, would be necessary for an engineer to form a correct opinion of the harbour; it would not cost more than 20*l*.

Mr. **O'NEILL** said that in proportion to the increase of the tolls and duties for the last 20 years, it was but reasonable to suppose that if the improvements were made the income would be doubled in 20 years.

HARBOUR MASTER.—The rocks at Grass Island ought to be removed. There are two bars of rocks below the city, near Barrington's quay; at low water there is four feet of water over them—they ought to be blasted. At present we have near 18 feet of water at neap-tides, and at springs we have 21; where the steamers come to there is generally 16 feet of water. There have been several wrecks down the river at the Beeves and Scarlet. The number of pilots on the river is sufficient for the duty; they pass an examination, and are generally speaking efficient men. They are not paid by the Bridge Commissioners, but by the masters of vessels, who require their services. The anchorage along the river is magnificent—such a fleet as the Walcheren expedition, which he saw himself, numbering 600 sail, could anchor in the Shannon. This he considered one of the reasons why Limerick is suited to the purposes of a transatlantic packet station; there was besides less fog on the Shannon than any other part of the coast of Ireland, owing to the sharpness of the land; next, the breadth of the river at Beagh Castle was so great that you could run the largest ship of war in there. If packets sailed from Limerick instead of the present circuitous route from Liverpool or Southampton, there would be a saving of 49 hours in time.—Again, coal could be procured here for steamers at 10*s*. a ton, as several vessels brought it over from other places as mere ballast, at a nominal freight, when coming to Limerick for grain.

Mr. **MYLES**.—I often purchased it for 9*s*. per ton, and sold it at a profit, but not this year, as it is up to 16*s*. per ton now.

Mr. W. H. **OWEN** examined.—I am ten years engineer of this port. My duty is to see the plans sent down by the Board of Works carried into execution, and all contracts fulfilled. Since I came into office the quays were built; the foundation is three feet below the bed of the river; the bed of the river is boulder rock and hard ground: it is loose, but I don't think it could be improved by a

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dredging-machine; am of opinion that it would be useless to deepen the river at the quays unless it was carried a great way down the river. It would be impossible to keep vessels afloat without a dock, as it would be only making a hole which would be soon filled up by the freshes, the character of the river being altered by the improvements going forward on the Upper Shannon. The freshes were formerly of a slow rise and fall, and used to fill up bogs and lakes connected with the Shannon, but now run off rapidly, consequently the force of the current through the harbour had increased.

Mr. OWEN, in continuation, said the bottom of the river was capable of being excavated, for the purpose of erecting a floating dock, for which an area of about ten acres would be required. The expense would be near 40,000*l*. As an engineer, would think it necessary to consult the harbour master and shipping interests before he proceeded to make any alterations or improvements in the port. On the Upper Shannon the river had been dredged and improved to a great extent.

Mr. DICKSON.—While the Lower Shannon, the great source of our commerce and revenue, has been entirely neglected.

Mr. OWEN.—The Shannon Commissioners built a pier at Kilteery, at the instance of Lord Clare and Mr. S. Dickson's brother; an application was made to the Shannon Commissioners to build a pier at Glin, but those locally interested would not contribute towards the expense; where a pier had been erected, the parties in the neighbourhood contributed towards its erection. He was connected with building the pier at Kilrush, and thinks it is constructed in a good direction for shelter: it is vertical, and has stood remarkably well; is of opinion that an upright wall resists the sea better than the long sea-slopes, such as are at Kingstown and elsewhere: it was in consequence of the bad foundation that the three angles were made—there is the *teredo navalis*, which destroys timber below Glin. I have heard complaints made by the captains of the steamers of getting their sponsons over the quay wall both at Kilrush and Limerick; though it was often spoken of, nothing has been done. Some money was expended at Athlunkard Bridge, in undoing what had been done.

COMMISSIONER.—The mode of construction of Kilrush pier is highly creditable to every one who had any share in designing it. I examined it carefully yesterday; it seems in perfect order, and I understand it has not cost one shilling for repairs since it was first erected.

WITNESS.—It was on the application of Mr. Scott, of Cahircon, the pier was erected at Kildysart; thinks it was for the use of turf-boats, which, however, did not avail of it. The Shannon Commissioners have not control over the Fergus, but tolls are levied at Clare. The expense of improving the Fergus would be great; but the traffic of Ennis and Clare required that the rocks should be excavated, and the dangerous impediments removed. The Shannon Commissioners erected a good quay at Clare.

Mr. BANNATYNE observed that for two years after it was built vessels could not lie at it, although ship-owners had to pay tribute. If completed it would be a great improvement, and he understood 1000*l*. would make the river as navigable as the Clyde.

Mr. OWEN.—The reason the quay was left so long unfinished was in consequence of a dispute between the contractors and Shannon Commissioners. He then stated that the distance from Limerick to Lough Derg was 12 miles, and that there was a fall of 96 feet. That would be got rid of by the railway from Limerick to Killaloe. The Shannon Commissioners have it in contemplation to remove the weir at Curraghgowor. In his opinion the Upper Shannon had been much improved, and he knew that the trade and commerce of Limerick had increased. He admitted that the improvements on the Upper Shannon would in some measure be useless if the Lower Shannon was not also improved. The Shannon Commissioners proposed to effect improvements in the port, but the Bridge Commissioners would have nothing to do with them.

Mr. W. ROCHE said he remembered when he was in Parliament the Bridge Commissioners declined because they thought there was no doubt of getting the grant of 40,000*l*. for the floating-dock.

Mr. OWEN admitted that the floating-dock ought to have been erected before the bridge, and said from the geographical position of Limerick, he considered it a most desirable port for a western packet station.

Mr. DICKSON.—As the construction of docks would be so advantageous, I suggested that a company should be established in Limerick for their erection; but it would not be acted upon lest the Board of Works should require the port duties.

The Rev. WILLIAM WALLER, of Castletown, examined.—He said a pier was very much wanted at Beagh Castle, owing to the great traffic in corn and butter from that district. He had applied frequently to the Shannon Commissioners, and offered to pay his portion of the expense, yet he could not succeed. The reverend gentleman represented the accommodation it would afford, and stated that turf-boats going down the river, when westerly winds prevail, could seldom proceed by the one tide further than that place, where they have to come to anchor, and are obliged to remain on the slob; the consequence was that when it blew hard, the boats were destroyed, and several lives had been lost in that locality. There was a portion of a quay there at present which had been built by his predecessor, and he considered a pier of 100 yards would be sufficient.

Mr. MARCUS KEANE, agent to the Marquis Conyngham, wished to represent a grievance of which the western pilots had to complain, namely, that their services were refused by masters of vessels coming to Limerick, who declined taking a pilot on board until they reached Tarbert, unless they made a bargain for 6*s*. or 8*s*. He knew the commissioner had nothing to do with such matters, but if anything to cure the evil could be done it would be of great service.

The Port Collector, Mr. REAYE, said pilots were never paid by the masters of vessels in Liverpool.

The COMMISSIONER considered the fault lay with themselves, one offering his services for less than another.

Mr. THOMAS WATERS, head Pilot, examined, confirmed all the Harbour Master had said, and added, that a light-house was much wanted at the Beeves, for which no application had been made to the Ballast Office.

DENIS QUILLIGAN, a Pilot of the Fergus, gave evidence as to the impediments in that river, which he described, and said if they were removed several vessels would prefer going there to

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coming up to Limerick. Port dues are exacted there, and an extra freight is charged by vessels, owing to the danger of the river.

Mr. R. **Russell** said they charged 2*s*. a ton extra. He then explained the necessity of making one of the arches of the new bridge, now in course of erection from Bank-place to Bridge-street, a swivel, with the view of admitting turf boats up the river, in order to accommodate the poor in the Old Town, who are put to great inconvenience by being obliged to go, especially in winter, to Arthur's quay, for fuel.

The **Commissioner** said the convenience and interest of the poor ought to be consulted in all cases.

Mr. **Owen**.—A great delay would be occasioned by its opening.

Mr. **Russell**.—It would not be more than a quarter of an hour's delay each tide.

Mr. F. J. **O'Neill** supported the suggestion of Mr. Russell.

The **Mayor** considered it was too late to think of it; besides, it was a great thoroughfare, and inconvenience would arise from the delay.

Mr. **Reaye**.—If it is an accommodation to the poor the inconvenience ought not to be considered. In Liverpool the delay is not a minute, owing to the construction of the swivel.

Mr. P. **Coghlan** said, the parishioners of the Old Town had memorialized the Council on this head, at the time the contract was being made. If any inconvenience did arise, it would be to the numerous residents in that quarter.

Mr. **Owen**, in reply to the Commissioner, said it was not yet too late to make a swivel bridge, and the expense would be from 500*l*. to 600*l*.; still there was a difficulty, both grand juries having contributed for the stone bridge.

Mr. **Dickson** said they could not interfere, as the money was levied.

The **Commissioner** trusted the corporation would reconsider the matter, as any partial delay that might be occasioned to passengers would be more than compensated by the advantage to the poor.

Mr. **Russell** said there was Ball's Bridge within a hundred yards for passengers to go over when the swivel was opened.

Mr. **Dickson** said, that he hoped to find, at last, some practical good likely to result, after so many repeated Commissions to obtain information at such enormous expense for the last 20 years, without anything ever since done to carry out any of the several recommendations of those Commissioners. He had no doubt but that at length tardy justice would be done to the merchants, traders, and citizens of Limerick, and their rights established. It appears that the harbour of Limerick, ever since building the bridge in 1823, remains in a most exposed and wretched situation, subject to great and ruinous loss in every storm, without a dock or place of shelter for vessels, after the trade paying upwards of 50,000*l*. bridge dues, which never could have been intended for building the bridge but for the erection of floating docks, as enacted by the Act of 1823. Still now, after 22 years, Limerick remains without a single dock, the shipping lying on the hard ground, exposed to every storm after such an expenditure for their protection, and an income exceeding 4000*l*. yearly, which the merchants submitted to in consideration of docks which will not now be made, though the dues are levied. An Act was passed in 1834, and one in 1839 (about which latter there was some strange manœuvring), but no service was done to the port of Limerick, though the city and county were taxed to an enormous extent. He found from a parliamentary return which had been moved for at his instance in the House of Commons (having been refused in other quarters), that the county of Limerick was taxed 2963*l*. and the city 900*l*. for dredging vessels at Banaher, &c., which were of no use to Limerick. This was the conduct of those who refused to allow one shilling to be expended on the port. They had expended, indeed, 1500*l*. in undoing their own work at Athlunkard Bridge. He referred the Commissioner to the able report of Captain Mudge upon the neglected state of the Shannon and the facility of improving it, also to the several reports of the Shannon Commissioners, to whom was granted the princely sum of 584,000*l*. for improving the navigation of the Shannon, still none of this great sum would be expended in carrying out the important improvements so essential and so repeatedly recommended by the several Commissioners employed for the purpose, and by removing those several impediments recommended by Captain Mudge—approved of and recommended by those very Shannon Commissioners, as also subsequently by a Committee of 41 Members of Parliament, especially appointed for the purpose, men of every shade of political opinions, who, 11 years ago, reported strongly in favour of carrying out Captain Mudge's recommendation, and hoped shortly to have it done.

No. 77.

Extract from Mudge's Report on the Shannon.

No. 77.

An Extract from Captain Mudge's Report, made in 1831, *of the State of the Navigation of the River Shannon, from Limerick to the Sea.*

The river Shannon is too shoal to permit vessels, drawing more than three feet, to lie afloat at low water above the Pool (about half a mile below the bridge); shipping alongside the Quays are obliged to lie aground when discharging or loading—a difficulty no way of surmounting, but by a floating dock; that a dock was constructing of this description, which would afford accommodation to a few vessels, but there would be great difficulty entering this dock as at present constructing; that a ship of 16 feet draft must be at the dock-gates precisely at high water; that a vessel drawing this quantity should anchor below Grass Island (nine miles) to wait tide, and could never be certain of arriving at the exact moment necessary, and should then remain aground at low water; to remedy which, a steam vessel should be ready to tow shipping into dock; with this assistance, provided the works were well constructed, they would most likely answer the trade of Limerick for some years.

That, at least, eight mooring buoys should be laid down in the pool for vessels to lie to. That, at present, the free passage was impeded by warps run out to shore across the river, and anchors, to great danger of running on them.

That he believed the river from Wellesley Bridge to the pool (half a mile) has less water than formerly, but it has deepened from thence to the Beeves (16 miles) about four feet. That lessening the water was undoubtedly owing to the deposits caused by the eddies and counter currents, which

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have been increased by this bridge (only building at the time), and extended half a mile below the bridge, where the free current commenced and carried away all obstructions not having a firm foundation, of which there were several, which from the narrowness of the river where they occur, impede the navigation so much, that it was only under favourable circumstances of wind and tide that a vessel could proceed either up or down.

The first impediment, a mile and a quarter below Limerick, was a bar across the channel from side to side, a ledge of rocks, foul ground—mostly large flags of limestone, some knobs rising two or three feet above the bed of the river. The removing this bar, or reducing it to a level with the bed of the river, would enable vessels to pass up an hour sooner, besides removing a danger proved destructive to more than one vessel. Then describes the loss of three vessels and cargoes in consequence thereof in a short period. That there would not be much difficulty or expense attending the removal of this obstruction in summer, when at low water there would not be more than four feet on the greater parts. He believed the stones were loose, but as they were never uncovered, it would require the use of the diving bell.

Next difficulty was the Cock Rock; but one buoy to mark the channel when there should be three others. The Cock Rock he considered one of the most serious difficulties a vessel had to encounter; it was three miles below the city, on the Bight of Tervoc, and runs nearly across to Connagh. This rock contracts the channel so much, that a vessel had not room to drop through till nearly last quarter flood, nor after first quarter ebb; that, with a falling tide and foul wind, a pilot ought never to take a vessel past this rock; that, if she were to touch on it, she would in all probability remain, to the great danger of bilging.

That he examined this danger as well as circumstances would permit, but could not ascertain whether protuberances were of a solid and fixed mass, or merely lying on the surface of the gravel bed; that a considerable part of loose stones, which used to be exposed at low water, were removed by the Chamber of Commerce, and he believed the remainder might be taken away and made even with the bed of the river, but the diving bell would be indispensable.

He strongly recommends that this Cock Rock and bank should be entirely removed, if expense not too much, which he did not believe it would, or that the protruding masses should be reduced. He recommends a buoy to mark the channel, and a few more down to Buckinish Point.

"The Ballast," a name generally applied by pilots to loose collections of stones, was a patch of that description lying on the mud, a little to the northward of Lady's Hole; they were bare every tide; the deep water and channel lie close to them. He recommends their being taken away, which could be accomplished in two or three tides, as they were exposed at low water.

Harrold's Rock lies on the north bank, 60 feet long, and from 20 to 30 broad, and protrudes from the mud about two-thirds of its length; it appeared to be solid limestone, five feet above the mud. All this rock uncovers every low spring, and was very much in the way of vessels, owing to the tide setting down the river directly upon it; therefore he strongly recommends that it should be removed, and as the expense would not be anything considerable, he thinks the good derived would more than compensate.

Some foul ground and a sunken rock off Cratloe was the next danger: there were barely three feet of water at low springs, but at half tide 11 or 12 feet. He thinks it would answer to put a buoy on it, and to remove some stones on the bank.

The Kippen Rock was the sixth danger from Limerick, and, with the exception of the Cock Rock, the worst in the river, owing to the channel being contracted by the middle ground, called the Whelps, and this rock running directly towards it; that it all uncovers at low water, and there were two fathoms alongside it; that it might be removed without much trouble, and be believed a bell would not be required. This would widen the channel, and permit vessels to border more on the north shore, and thus keep clear of the spit of the Whelps, and the tide would have a free uninterrupted course down channel.

A quarter of a mile north of the Kippen Rock, another cluster of limestone should be taken away; it tends to contract the channel at half tide.

The Whelps, a cluster of seven solid limestone rocks, protruding through the north end of a long sand bank; the stones could be easily removed, as no part was under water the last hour of the ebb; that this would considerably lessen the dangers of this part of the channel, which was narrow, and the tide runs with great velocity; besides, it would permit a vessel at half tide passing safely between them and the Scarlets; recommends six buoys to be placed, and that the Whelps require four.

That a patch of rocks should be taken away lying nearly abreast of the Whelps: they are entirely exposed at low water, but in the event of the Harrold and Kippen, &c., being removed, they would become serious impediments while covered, as the tide would set down upon them, and strike across the Whelps.

The Crawford Rock has been the cause of many disasters to shipping frequenting the port of Limerick, and should be removed, and as the greater part uncovers at low water, there would not be much difficulty in clearing it away.

Shawn-a-Garra lies a few yards lower down, seldom exposed at low water, therefore very dangerous; he thinks it consists of three or four knobs of limestone, from five to six feet above the bottom, close to these rocks four fathoms; and if they could be removed by the bell, he recommends it to be done; in the mean time buoys should be placed there. That the tide sets upon the Shawn-a-Garra with great force, and with the present confined navigation, with the Whelps on one side this rock, on the other be can only wonder how so few accidents have occurred.

The Scarlets appear to be all rocks or large stones, and the greater part might be easily taken away. The Chamber of Commerce cleared a portion, but there was much to be done, and strongly advises that a bell should be employed to clear the stones and shingle away; the sand and mud might then be dredged out.

Greog Island, north side, opposite the Scarlet. From off this island a ledge of rocks and stones extends some yards, and he advises that they should be taken away; it would considerably improve the navigation, and lessen a great deal of the danger of the north channel.

Two or three patches of loose stones opposite the Scarlets, and abreast the Whelps, ought to be removed, and may be done with the greatest facility, as they are of all dimensions, and uncovered at low water.

The Slate Rock, in centre of the channel, nearly round, about 20 feet in diameter; it should be removed, and from the smallness of it, and being composed of loose stone, the greater part could be easily broken up.

APPENDIX B.

LIMERICK.

No. 77.

Extract from Mudge's Report on the Shannon.

Hogshead Rock, a very serious obstruction, uncovers every tide; some portion, being loose stones and coarse shingle, would not cause much expense, nor would there be much difficulty in clearing it away. This part of the channel was but a quarter of a mile broad, and two or three vessels were damaged on these rocks.

The mud flat of Bush Island ought to be buoyed, and a patch of stony ground should be taken off the mud flat in the bight opposite the Hogshead, and a buoy placed there to mark the channel; his sketches are given to illustrate those matters.

Battle Island—some directions are given for its improvement; Laheen's Rock lies on the edge of the shoal; that the tide sweeps past it with great velocity; there were 15 fathoms close to the rock; that this danger should be entirely removed, and well worth the expense. It contracts the passage between Battle and Grass Island to 70 or 80 fathoms, but was in itself very dangerous, being nearly steep; that a vessel might strike upon it at half tide, and fall over on the deep side, and, in all probability, cause her to fill and go down.

Grass Island—some directions are given and no great expense; then the navigation is unobstructed for a mile to the Big Bird, upon which the tide sets with all its force; this rock almost blocks up the north channel; it shows every tide; by its removal a serious danger will be destroyed, and a fair and better channel thrown open; recommends several buoys.

There are four rocks, sand rocks, bridge rock, &c., which he strongly recommends being taken away, and points out the advantage of it, and also that Sullivan's Rock, which uncovers every tide, ought to be taken away.

A tower, now on the "Beeves," might be easily converted into a light-house, and he could not too strongly recommend it. This would enable vessels outward bound to take advantage of a few hours' spurts of wind at night, to start from Grass Island, and possibly prevent the detention of many weeks. That westerly winds prevail nine months out of twelve, and when set in, continue six or seven weeks, and as they generally blow with violence, seldom a vessel would attempt to work against them. That such detention was a sad damper to commerce, and as it might, in many instances, be obviated by a light on the Beeves, he most strongly recommends it. That be considered it one of the greatest improvements that could be made on this river, for vessels homeward bound would sail in from the sea to Grass Island at night, or take advantage of a fair wind that might last a few hours, for large vessels should have a leading wind to take them up to the quay. That a light was building on the Point of Tarbert, which, with the light of Kilkadrane, and the one proposed on the Beeves, would complete the connexion for 40 miles, and render this much of the river quite as safe by night as in the day, and be of great assistance for vessels bound out of the Fergus, and enable them to sail at all hours.

No. 78.

No. 78.

Rhodes on the Port of Limerick.

Report of THOMAS RHODES, Esq., *Civil Engineer, upon the Port of Limerick, for the purpose of making Floating Docks.*

Limerick, 7th June, 1833.

SIR,

AGREEABLY to your instructions communicated to me on the 15th April, by order of His Excellency the Lord Lieutenant, to furnish plans, report, and estimates for improving the Port of Limerick, I proceeded to make the necessary investigation and survey, and find that it can be effected at a small comparative outlay, affording ample accommodation for all classes of vessels likely to resort to this place for trade, which might lie afloat, and take in and discharge their cargoes with facility and expedition; and also for vessels driven in by stress of weather, and wanting repairs, instead of being obliged, as they now are, to run for Cork, Waterford, or the Bristol Channel.

Limerick is the principal city, emporium, and chief market for the whole of the west of Ireland; it is situated upon the south bank of the River Shannon, at the termination of the estuary or tideway, distant from the Atlantic Ocean 70 miles. The upper part of the city, called New Town, is of modern erection, the houses spacious and well built, and the residences of the most respectable inhabitants and merchants; the streets are wide and well lighted. The other part, called the Old Town, presents a different aspect, being mostly old and dilapidated buildings; its streets are confined and narrow, and badly kept in repair, and not being lighted at night, it presents a gloomy appearance. The only thoroughfare at present leading to the counties of Clare and Galway is through this part of the city, passing over Thomond Bridge. This structure is composed of 14 arches, and is very ancient, said to have been built by King John, and is in a most dilapidated state; it would seem to be advisable, when the roads over the Wellesley Bridge and the Athlunkard Bridge are completed, that it should be taken down and rebuilt (in a manner better calculated for the discharge of the Shannon waters), and the approaches improved.

The population of Limerick, according to the last census (1831), is 67,575 inhabitants, chiefly engaged in agricultural pursuits, and the business of the port; the staple manufactories being of a very limited description, and appearing to receive but little encouragement: there is one extensive distillery, two small iron founderies, and a little done in the glove trade, for which it was once so celebrated, and a lace manufactory.

Great quantities of grain, flour, oatmeal, butter, beef, pork, &c., are exported annually to the English and other markets, which, according to the statistical returns of last year amounted to 1,005,726*l.* 13*s.* sterling; the imports were also extensive, amounting to 289,595*l.* 12*s.* sterling, both of which are very much on the increase as compared with former years; and there is every prospect of a continued increase, as advances are made in the improved system of the cultivation of the soil, which is generally so rich and productive; and by superior lines of communication, affording an easy means of transit for the various produce.

The ports and quays afford very indifferent accommodation for the shipping, they having to lie aground at low water each tide, upon the hard bottom, which is chiefly composed of solid limestone-rock, producing great injury to laden vessels, particularly to sharp-built craft. Ships of from 300 to 400 tons burthen, laden with timber, &c., are obliged to discharge their cargoes in the pool, about a quarter of a mile below the city, in about 1½ fathoms water, for the purpose of lightening them a little; discharging them at this distance is attended with considerable extra expense: coasting vessels of light draft, say 13 to 14 feet, have frequently to unload part of their cargoes at the lower quays, and when thus lightened, they proceed to the next, and so on to discharge the remaining part; the various quays are private property, and in such cases the charges become exorbitant for wharfage.

APPENDIX B.

LIMERICK.

No. 78.

Rhodes on the Port of Limerick.

This risk, detention, and expensive mode of doing business, is much against the interests of the merchants and traders of this city, and is a means of deterring merchants from chartering their vessels for Limerick.

An Act of Parliament was obtained, in the year 1823, for constructing a bridge and a floating dock, (the works were commenced in 1824), neither of which are yet completed. As regards the floating dock, when finished, it appears far from adequate for containing even the tenth part of the shipping that would resort to this port, if accommodation was afforded for their safety.

To obviate these difficulties by providing a safe harbour for shipping, is the object of this inquiry; and to accomplish so desirable an end, I propose to construct a dam or weir across the river at Kelly's Quay, to dam up the water,* and thus convert all that part of the river above into floating docks, which will be more fully understood by an inspection of the accompanying drawings.

The General Plan, No. 1, exhibits the Port of Limerick, with the various quays along the river, Wellesley Bridge, and the proposed docks as projected in 1823, Thomond Bridge, Baal's Bridge, part of the Abbey River, and the entrance to the Limerick Navigation, &c.

The soundings describe the depth of water in the various parts above the proposed weir, taken from a datum line, 15 feet above the sill of Wellesley Lock, and those below the weir at low water, datum line two feet above the sill of Wellesley Lock. Mooring buoys are described in the centre of the docks, both above and below the bridge, for vessels laid up, waiting for cargoes, rigging or slight repairs, thus leaving the quays free for the working of other vessels; the vessels described on the Plan are of large dimensions. The projected improvements for the docks and quays are tinted red.

The proposed weir at Kelly's Quay is intended to be placed at right angles to the river, in form of a segment of a circle, whose chord is 500 feet, and versed sine 100 feet, to be built as described on plan and sections, the upper surface to be 15 feet above Wellesley Lock sill, which level will be extended to the Limerick Navigation, and to Thomond Bridge. It is also proposed to construct 13 openings in the masonry of the weir, each four feet by three feet, a little above low-water mark, and each to be furnished with a cast-iron sluice, and proper machinery for working the same: these sluices are intended for the purpose of regulating the height of the water in winter time, when the floods descend, or as necessity may require; and also for the purpose of scouring out the docks, and carrying away any sediment that may have accumulated at the bottom, or be held in suspension by the lower stratum of fluid; in summer time, when the water is low, these sluices may be closed, as in that season but little head of water will pass over the weir.

For the convenience of approaching and working the sluices, it will be necessary to construct a foot-bridge across the dam, to be supported by light pillars of masonry, or by cast-iron vertical frames, and covered with planking, finished by a neat iron railing; this bridge would also form a communication for the increasing population of this part of the town, and a necessary connexion between the locks; it will also be a great convenience for the persons connected with the shipping.

It will be necessary to construct two locks, one at each end of the weir, the sills to be three feet under low-water mark; these locks should be 180 feet long, and 40 wide, or one of them might be 45 feet wide, to admit the largest class of steam vessels; the gates to be provided with four sluices each, for the purpose of scouring the docks at low water; but for the more effectual performance of this operation, the lower gates on each side might be constructed upon the balance principle: by adopting these improvements, the gates would not be required at the Wellesley Lock, which might be appropriated to these.

By having two locks, the one might be used for the admission of turf boats and small craft, and the other exclusively for large vessels; either might be used in case of derangement or repairs being wanted, which would always insure access to and from the docks at the different states of the tide.

When the tide is out, the weir will retain a sufficient depth of water to float the largest vessels which are likely to trade to this port, and might lie alongside the quays below Wellesley Bridge, viz., Harvey's Quay, Russel's, Kelly's, &c. Smaller craft, not drawing more than 12, 13, or 14 feet, would find accommodation above the bridge, viz., at Spaight's, Arthur's, and the Custom-House Quays.

By these arrangements the canal vessels from the Limerick Navigation would be enabled to ply at all times to and from the docks, and load and unload their cargoes from the quays or any of the vessels lying in the harbour, producing a great saving in cartage and other expenses.

The bottom of the present river course, to form the proposed docks, will require to be excavated and levelled along the present quay-walls to one foot below low-water mark, from the proposed weir to Wellesley Lock, on the south side, and the same on the north side; and it will be requisite to build a quay or retaining-wall, from the intended lock, to join the wall now building connected with the bridge works.

From the upper gates of Wellesley Lock, along Spaight's, Arthur's, and the Custom House Quays, the ground must be excavated to one foot below the sill of the gates; and the same must be done on the north side of the river, clearing away Curragower Mill and weir; and a retaining-wall must be built from Thomond Bridge to connect and continue the line to Wellesley Bridge.

The whole of the old quays, which are represented by a blue tinted line, form at present a very irregular and indented line; and it would seem advisable to purchase this property, take down the walls, and rebuild them according to the form represented on the Plan, and coloured red; the old materials would go far in rebuilding them. Upon the new line of quays, bonded warehouses, grain stores, &c., might be erected, and the whole enclosed by a wall, leaving a cartway at the back (for taking in or delivering the various produce) to be approached by gates from the streets, as described on the Plan; this would form one continued line of quays from Kelly's Quay to the Custom House, and the warehouses or stores might be erected nearly in a line with the front of the quays, supported by columns, which would form a piazza; and goods might be landed by means of cranes, examined, and housed dry immediately from the vessels; grain also might be shipped off in bulk with great facility, by means of shoots, descending from the stores into the vessels, which would save great labour and expense in cartage, &c., as compared with the present method of having stores in the centre of the town: these arrangements, it is conceived, would be advantageous both to the merchants and official persons connected with the customs. The quay walls would require protecting by timber defenders, placed at convenient distances, and having mooring rings to secure the vessels. A provision has been made in the estimate for a sewer at the back of the quay walls, to convey the drainage and discharge it below the proposed locks.

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* Similar in effect to what is now done at Curragower and Golden Mills.

APPENDIX B.

LIMERICK.

No. 78.

Rhodes on the Port of Limerick.

As graving docks or slips are much wanted at this port for the repairing of vessels, I have described on the Plan No. 1, convenient situations for these purposes on the north side. Near to the Shelbourne Road is the proposed site for a dockyard, with two slips or inclined planes, and a graving dock, which could take in vessels at all times; and on the south side, immediately below the lock, is a site appropriated for another graving dock, which could take in vessels at or near high water. It is conceived that these conveniences would be an additional means of increasing the trade and revenue of the port, and of giving employment to a great number of its inhabitants.

The erection of the proposed weir will give a considerable fall of water, and offers superior situations for two tide-mills, which might be employed for any manufacturing purposes; an elevation and plan of these mills are described upon the Drawing No. 2. A portion of the power of one of these mills might be advantageously employed in pumping water, to be conveyed through iron pipes into a reservoir that might be constructed on the elevated ground near to the military barracks, and thus the town could be supplied with soft water, which, by filtration at the reservoir, could be distributed to the inhabitants in a pure state; the situation here described is sufficiently elevated to discharge the water to the tops of the highest houses, being, according to levels taken, 65 feet above the high-water mark. This would be a valuable increase to the health and comfort of the inhabitants, and its want has been long and severely felt, the city hitherto having been supplied by water-carts from the river and springs,* and by small pumps, yielding water of an unwholesome quality, being strongly impregnated with sulphate of lime (as I am informed by a medical practitioner); this is particularly unhealthful to strangers visiting this city, and is frequently the cause of much suffering to the troops stationed here.

These mills, if constructed, would be of great value, and would be much more than a substitute for the two mills of Curragower and Golden above, which would necessarily be stopped by the erection of the proposed works. Hogan's Mill, situated near the canal, would receive no injury; and Corbally Mill, near the salmon weir, would rather be enhanced in value, as the removal of the weirs and mill at Curragower, and clearing under the arches of Thomond and Baal's Bridges, will tend to lower the head of water, and free the tail-race of these mills.

On No. 1 Plan is exhibited a line of embankment on each side of the river (below the proposed weir), for reclaiming considerable tracts of waste land, which, if executed, would yield a profitable return. The general surface of this land is from five to six feet under the high-water mark of spring tides; the embankment on the north side is just begun, and if a corresponding line was made on the south side, it would much improve this part of the river, besides reclaiming the land; and when these embankments are completed, the slope next the river being faced with stones, the other planted with trees, and the top gravelled and protected, they will form fine esplanades for the healthful exercise of the inhabitants, heightened by the pleasing appearance of the cascade, and the entrance to the docks. The land thus reclaimed could be drained, and the water discharged by tide sluices through the embankments, as described upon the drawing.† This land would form excellent pasturage or gardens, the soil being a fine alluvial deposit, chiefly of a calcareous nature; this is a fortunate occurrence, as it seems very probable that Limerick will quickly be extended in this direction, and its respectable inhabitants will be induced to occupy villas, &c., built upon the banks of the Shannon in this vicinity.

Great improvements might be effected upon the river below Limerick, as already described in the Report by Captain Mudge, and I would beg to submit, that, in addition to his valuable suggestions, if groins or projecting walls were constructed in some of the wide and irregular parts, where it is not prudent to embank, so as to leave the river nearly a parallel width, a mid-channel current would be produced, which would scour out the mud and other matter from the bottom, and thus keep a clear waterway, and give a greater depth up to Limerick. Very much has been done in this manner of late years upon the rivers Clyde, Dee, &c., and many other rivers in Great Britain, producing an astonishing effect in the course of a few years, and has been the means of increasing the trade and wealth of those places to a great extent; and it is not too much to suppose that the same results would be obtained on the River Shannon, if a similar spirit of enterprise and speculation was entered into by the merchants and landed proprietors connected with the city of Limerick.

Excellent materials in limestone, suitable for building purposes, and for the projected works, are on the spot, requiring only the labour.

In forming the estimates a considerable degree of care has been taken in obtaining the correct quantities, and the prices attached to each are such as would leave a fair remunerating profit for the due execution of the several parts specified.

The valuation of the different properties that would have to be purchased are estimated from the best information I could obtain, calculating from an annual rent at 20 years' purchase.

I have, &c.,
THOMAS RHODES.

To Colonel Burgoyne,
&c. &c.

ESTIMATE.

Docks and Quay Walls.	£.	s.	d.	£.	s.	d.
188,035 yards cube.—Excavation to level the bed of the river, including the excavation to level the bottom for the proposed weir and locks (partly rock in a loose state)	9,401	15	0			
21,357 yards cube.—Rubble masonry in quay walls from the proposed weir to Thomond Bridge . . .	10,678	10	0			
No. 232.—Timber defenders to face of walls . . .	928	0	0			
No. 80.—Mooring rings	320	0	0			
No. 24.—Mooring buoys	960	0	0			
				22,288	5	0

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* A plentiful supply of good pure water may be obtained about from three to four miles on the Tipperary and Waterford Road, and might be conveyed in conduits to the city.

† The tide sluices in the embankments about Limerick are very inefficiently executed, thereby not performing the drainage in an effectual manner.

No. 78.
Rhodes on the Port of Limerick.

	£	s.	d.	£	s.	d.
Brought forward	..			22,288	5	0
Weir and Foot Bridge.						
16,800 yards cube.—Rubble masonry	11,340	0	0			
2,488 yards cube.—Ashler work to face and top of weir .	2,799	0	0			
Extra to 13 tunnels worked through the masonry of the weir for the regulating the sluices	390	0	0			
2,240 feet cube fir timber in foot-bridge over weir . .	448	0	0			
Thirty-three tons of cast iron in 22 frames, to support the bridge	462	0	0			
1,120 feet run, wrought iron balustrade and handrail, including sockets and bolts, &c., for fixing, complete .	560	0	0			
No. 13.—Regulating sluices of cast iron, 4 feet by 3 feet, faced with brass, iron spear rod and guides, rack and wheel work, fitted up complete	1,300	0	0			
				17,299	0	0
Locks.						
7,045 yards cube.—Rubble work in backing and contreforts	4,755	7	6			
3,775 yards cube.—Ashler work to face of walls, hollow and quoins, square quoins, &c.	4,246	17	6			
902 yards cube.—Filling in and puddling between walls and behind contreforts	56	7	6			
Two pair of timber gates, with machinery, footbridges, and sluices, opening gear, &c., complete	3,200	0	0			
Four capsterns	120	0	0			
Six mooring posts	24	0	0			
For one lock . . £	12,402	12	6 2			
For two locks				24,805	5	0
1,400 yards run of sewer from Arthur's Quay, to discharge the drainage below the proposed weir				1,750	0	0
Purchase of property to form the proposed quays, the rentals amounting (as nearly as can be ascertained) to £500				10,000	0	0
Contingencies, at 10 per cent.				6,614	0	0
Total Amount . . . . £				82,756	10	0
From the above sum				82,756	10	0
May be deducted the amount of gates, as estimated for the Wellesley Dock	5,026	0	0			
Ditto, amount of wall, as estimated to form the Custom-house dock	24,000	0	0			
				29,026	0	0
£				53,730	10	0

THOMAS RHODES, *C. E.*

No. 79.
Roche on damage to Limerick Bridge by the gale of 6th January, 1839.

No. 79.

MR. J. ROCHE, *on Damage to Limerick Bridge during the Gale of 6th January*, 1839.

Limerick Bridge Commissioners' Office,
11th January, 1839.

SIR,

I am directed by the Limerick Bridge Commissioners to state that considerable damage has been sustained in this port during the terrific hurricane of the night of the 6th instant, when several vessels broke adrift from their moorings, and were dashed against the Wellesley Bridge, levelling the greater part of the western parapet, injuring the quay wall near the bridge, and carrying away a great portion of the dock-gate house. Along the line of the new quay partial injury has been done also. Two breaks, of nearly 200 feet each, were made by the force of wind and tide in the bank on the north shore, on the property of the Commissioners; and the several houses, stores, and buildings in their possession have suffered more or less injury. So extensive are these injuries, that a large outlay will be necessary for permanent repair; and under these considerations the Bridge Commissioners delay any steps further than precautionary ones as to personal safety of passengers, and temporary repairs to some of the premises, until your Board have the matter laid before them. And I am directed to suggest how satisfactory it would be, if your Board directed one of your own engineers, or, if possible, one of the members of your Board to visit the port—first, to ascertain its present position, and prescribe the necessary repairs; and, next, to confer with the Bridge Commissioners if it may not be practicable to devise some means of preventing a recurrence of such a calamity. The damage done to the shipping in this port is estimated at 30,000*l*., and this damage was entirely confined to the vessels below the bridge, no injury having been sustained by any vessels lying in the dock, or above the bridge. I am directed to report that no injury has been sustained by any of the arches of the Wellesley Bridge.

I have, &c.,
JOHN ROCHE, *Secretary.*

H. R. Paine, Esq.,
Secretary to Commissioners of Public Works, Dublin.

No. 80.
Rhodes on the Damage done to Limerick Bridge, Docks, &c., during the Gale of the 6th and 7th Jan., 1839.

No. 80.

Report on the Damage done to Limerick Bridge, Docks, &c., during the Gale of the 6th and 7th January, 1839, *by* Mr. T. RHODES.

SIR, *Limerick, 24th January,* 1839.

I HAVE been favoured with your letter of the 17th of January, requesting me to examine the bridge and dock works at Limerick, and to report on the mischiefs done to them by the hurricane of the 6th and 7th instant.

I also received instruction from the Board of Works to a similar purport; and after a careful examination of the works on the 22nd and 23rd, I beg to state the following particulars:—

In the first place, I am happy to inform the Commissioners that the extent of injury done is not so serious as I was led to apprehend from the tenour of your letter to the Board of Works of the 11th instant. The parts injured are as follows, viz.:—

1st. The Wellesley Bridge and watch-house.
2nd. The river wall projecting from the bridge.
3rd. The coping of the old quay and wall.
4th. New quay wall.
5th. Slating to office in Henry-street, to Walker's factory and storehouse. And,—
6th. The river embankment.

1st. Commencing with the survey of the bridge, I am happy to say that the whole of the arches and piers have not received any injury. The external spandrel wall over the first pier, on the Limerick side of the river, has been considerably injured by the vessels breaking adrift from their moorings on the north side of the river, and driving with great violence against the western side of the bridge, and have stove in a considerable portion of the ashlar work, which will require to be taken up and replaced where necessary with new stone. The vessels, also, were battering against the parapet during the continuation of the gale, and swept off about 208 feet in length of the parapet, besides knocking away the north-west angle of the watch-house adjoining the end of the bridge, which will have to be renewed with fresh stone work. However, a portion of the blocking course, ballisters, and coping may be used again for the parapet.

2nd. The river wall projecting from the bridge, the coping of which for a considerable distance has been driven in, and dislodged from its bed in many places; besides, several courses of the masonry downwards, and the pier-head at the termination of this wall, have similarly suffered hy vessels breaking away from their various moorings, along the quays on the south side of the river, and driving against it, has broken a great deal of the ashlar work, which will have to be taken out and renewed with fresh stone work.

3rd. The coping of the old quay and the face of the wall have been considerably disturbed, the whole of which is in a dilapidated state.

4th. *The New Quay.*—With respect to the new quay, I am happy to state that it has sustained very little injury; but from the great number of vessels that were lying alongside at the time, being mostly three tier deep for the whole of its length, and the vessels that were lying at the lower quays having broken away from their moorings, and running foul of the vessels at this quay, caused a great additional strain, by which nearly the whole of the chain and rope cables and warps of the different vessels were broken; and two of the mooring-rings were torn from the eye of the shank, and appear as if they had been cut by a pair of shears. The rings are of 2½ inches iron. The shank and plates have stood firm. Two mooring-posts of stone were drawn out of their solid beds of masonry; which was no doubt caused by the short scope of cable the vessels were riding with, and the sea running high, produced violent concussions of the vessels against the wall; and, although firmly built, the coping and a few ashlars have been slightly moved and driven in, besides some injury to the upper part of the steps—the whole of which can be adjusted at a comparatively small expense.

5th. The different house properties of the Commissioners have been more or less injured by the storm, in the roofs, slating, and glazing, but not to any serious extent.

6th. The river embankment, the property of the Commissioners, extending 1,630 feet in distance from the Shelbourne Road down the river, has been a good deal damaged on the upper parts, by the sea breaking over it, and caused two breaches from 3 00 to 400 feet in width. These are in active course of being repaired; and I should hope to be able to close them these present neap tides. By paving the face of the slope next the river with rubble-stone paving, no further damage need be apprehended.

In conclusion, I do not think any very serious mischief has been done to the works, considering the violence of the hurricane, and I am satisfied the estimate will rectify the damages; but at the same time I would respectfully recommend that the harbour-master be directed not to allow more than two tiers of vessels at any of the quays, as no moorings can be safely calculated upon in heavy weather with such a short scope of cable, to safely hold more than two tier deep; and this also shows the necessity there is to provide greater accommodation for the shipping, by extending your quay wall towards the Steam Packet Wharf and Kelly's Quay. And as it is not very likely we shall soon be visited with another tempest of the same degree of force and violence, I do not consider it will be necessary to provide stronger posts and mooring-rings, as they appear amply sufficient under ordinary circumstances.

But, as a further precaution, a certain number of mooring-posts or rings fixed near the footpaths on the quay (50 feet from the front), so that in case of need they may he ready to use. I would also recommend that mooring-posts be put down on Kelly's and Meath's Quays, as the old ones were proved to be very insufficient; and, in all probability, if they had not given way so much mischief would not have been done to your shipping; and the same observation equally applies to the north side of the river, where proper moorings are also much required.

John Roche, Esq.,
&c. &c.

I am, &c.,
THOS. RHODES.

Estimate for Repairing the various Works damaged by the Hurricane of the 6th and 7th Jan., 1839.

No. 1.	Bridge and watch-house	£200
2.	River wall and north pier-head	30
3.	Old quay wall and coping	30
4.	New quay and steps	30
6.	Roofing, &c.	40
6.	Repairing river bank	170
		£500

No. 81.
Wolfe on the Lower Shannon.

No. 81.

Letter by Lieut. WOLFE, *R.N., on the Lower Shannon.*

Limerick, 3rd *September*, 1839.

GENTLEMEN,

It may not be considered presumptuous in me, or irrelevant to the duty on which I am employed, to address a few lines to you on the state of the Lower Shannon.

My progress in its examination has not yet extended below Grass Island; but in that short distance I have seen enough to excite my surprise at the neglected state in which the navigation is allowed to remain, for the want of buoys, beacons, and leading marks. But aware that a sum of money has lately been granted for the improvement of the Shannon generally, I feel impelled by a sense of duty, as well as interest in the survey on which I am engaged, to suggest that some exertion might be made to obtain a portion of that sum for so desirable—nay, so necessary—a service as the improvement of the Lower Shannon. Scarcely a vessel ever goes up or down the river without grounding; and, though some intricacies may have good leading marks, yet there are few pilots whose minds can be constantly on the stretch, in looking out for them, especially when also engaged in working the ship.

I would recommend the buoys, where required, all on one shore to be black, and on the other white, while those marking mid-channel shoals and rocks might be varied by red, chequered, or beacon buoys. Much might also be done towards removing the rocks that obstruct the upper part of this navigation, as many consist chiefly of loose stones, and where the rock is solid, it might be blasted.

The buoy which once marked the north point of the Scarlet Russ now lies among the rocks, and only requires staunching to resume its duties.

I remain, &c.,
JAMES WOLFE, *Lieut. R.N.*,
In Charge of the Survey of the Shannon.

To the Limerick Bridge Commissioners.

No. 82.
Memorial of Limerick Bridge Commissioners, 1841.

No. 82.

The Memorial of the Limerick Bridge Commissioners.

Limerick, April, 1841.

HUMBLY SHEWETH,—That your Memorialists were incorporated by virtue of an Act passed in the fourth year of the reign of his late Majesty King George IV., for the purpose of "erecting a bridge across the River Shannon, and making a floating dock to accommodate sharp vessels frequenting the Port of Limerick."

That to provide a fund for defraying the expense of erecting such bridge, and of making and maintaining such floating dock, your Memorialists were authorized to levy certain tolls on passengers, horses, and carriages, crossing the said bridge, when erected, certain tonnage rates on vessels frequenting the port, and certain duties on exports and imports, as in the said Act mentioned.

That the tonnage rates and duties on exports and imports were agreed to by the merchants of Limerick, in consideration of the great benefit which the trade of that city would receive from the construction of a floating dock.

That in consequence of a Memorial addressed to the Irish Government in 1833, Mr. Rhodes was directed to survey and report on the harbour of Limerick, in connection with his general survey of the River Shannon; and he recommended to the Government a plan extending the original design of your Memorialists, but which also embraced the formation of a still-water floating dock, capable of affording shelter and protection, at all times, to the shipping frequenting the port.

That the probable cost of such works, according to the estimate of experienced engineers, was 85,000*l*.

That in pursuance of such recommendation, and on the basis of such estimates, your Memorialists applied for and obtained an Act of Parliament (4th and 5th Wm. IV., ch. 84), for carrying such works into effect; and by the same Act (s. 11), the Commissioners of Public Works are authorized to lend for the purpose of effecting such works any sum not exceeding 20,000*l*., with the approbation of your Lordships, even though the amount of the rates shall not be equal to the discharge both of the interest and the payment of one-twentieth part of the capital annually.

That to provide an additional fund for securing the loans necessary for these objects, such last-mentioned Act, imposed upon the trade of Limerick additional tonnage-rates (about double the amount of those sanctioned by the first Act), to commence from the time at which the private quays were purchased, such being one object of the Act, and still further dues (in some cases double, and, some instances, half as much again as the former increased dues), to commence from the time the docks were completed.

That, in expectation of obtaining the protection, by a still-water navigation, which the trade of Limerick so much requires, these increased burdens were willingly consented to by the merchants.

That the Board of Works hitherto effected, under the authority of the last-mentioned Act, by two advances, amounting together, to 45,000*l*.; and the residue of such works can be effected within the original estimate.

That your Memorialists had hoped that the completion of their harbour would have come within the scope of the improvements of the River Shannon, lately sanctioned by Parliament, and, under this feeling, addressed a Memorial to your Lordships in the last year; but the fact of the inability of the Commissioners to apply any part of the funds at their disposal to such object, tends to show that the completion of the harbour of Limerick (which is rendered more important by the improvement of the Shannon), was considered to be adequately provided for by the existing Act.

That the Board of Works has lately entered into possession of the tolls, rates, and duties, levied under the authority of the said Acts; and, though your Memorialists strongly doubt the right of the said Board to take such possession, so long as the interest on the said loans of 45,000*l*. is regularly paid, yet your Memorialists willingly consent to any superintendence and control, which may tend to procure for the trade of Limerick that security and protection which the completion of the harbour would afford.

That since, as before stated, the Board of Works is authorized by the last-mentioned Act (s. 11) to advance, with the approbation of your Lordships, the sum required for the completion of the said harbour, your Memorialists trust that, on consideration of the importance of the works, not only to

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No. 82.

Memorial of Limerick Bridge Commissioners, 1841.

the trade of Limerick, but to the public interest also, and, as your Memorialists humbly suggest, of the ultimate safety of the loan, your Lordships will be inclined to approve and direct such loan, the more particularly as there is a sufficient fund for payment of the interest thereof, and a fund, when the docks are completed, for payment of the principal.

That in support of the assertion that the completion of the harbour of Limerick, by the formation of a floating dock, is of great importance, as well to the public interests as to the trade of Limerick, your Memorialists beg most respectfully to refer to their former Memorial, with reference to the great losses sustained by the shipping during the last two winters; and to the report of Mr. Rhodes to the Irish Government, and the experience of nautical and trading men, by which such works are recommended, as the only means by which to prevent the dangerous effects of the heavy and westerly storms.

That it was in prospect of this most important accommodation, that the trade of Limerick originally consented to the taxation imposed by the 4th Geo. IV. c. 94, and to the increased duties established by 4th and 5th Wm. IV. ch. 84, and to bear the still further increased duties, which under the last-mentioned Act are payable, when and so soon as the docks are completed; and your Memorialists have much reason to fear, that unless increased safety be provided for the vessels frequenting the port, a large portion of them will cease to trade thither.

That the facts stated in their former Memorial will, as your Memorialists hope, suffice to convince your Lordships of the greatly increasing importance of the trade of Limerick, and the consequent security of the loan now sought; and they beg to bring more distinctly before your Lordships the fact that, immediately the docks are completed, the tonnage duties are very greatly increased. And, without troubling your Lordships with the entire schedule, they venture to put before your Lordships the three first of the schedule, in explanation of such increase.

	Present Duties.	Prospective Duties.	
	d.	*s.*	*d.*
For every ton of the admeasurement of every vessel, reporting at the Custom-house of Limerick from any port in Great Britain, for every voyage	6	0	9
Ditto, from any port in Ireland	5	0	9
Ditto, from any port not in Great Britain or Ireland	7	1	3

That it is obvious from hence that the desired expenditure will be met at once with an increased income, without waiting for the certain though more slow increase of trade which increased facilities will bring; the increase of the import and export duties having more than doubled since even the present partial accommodation was given to the shipping.

That your Memorialists beg to refer to their former Memorial in proof of the manner in which the harbour dues have, of late years, risen in amount, and the augmented value of the customs at the port; and they may fairly calculate on a valuable internal trade from the improvement of the Shannon.

That your Memorialists are so situated that by no means, except a public loan, can these important objects, so urgently required by, and of such vital importance to, the mercantile interests of Limerick, be obtained, as the advance already made; and the large powers possessed by the Government Board render your Memorialists unable to offer any security to private individuals.

That your Memorialists beg, in conclusion, to remind your Lordships, that the sum required is not an additional, unexpected, or extravagant outlay, but is only the sum which the works were originally estimated for by engineers of the Government, which was stated in the estimate delivered into Parliament on obtaining the last Act; and that consequently the completion of these works forms part of the scheme and plan, on the faith of the entire completion of which that Act was brought in and agreed to, and without which the shipping complain of being taxed.

That the loan now sought for to complete the said harbour will only require the sum of 40,000*l.*, and for which there is a sufficient increase to pay the interest of it, and of the last loans, and a proportion per annum for payment of the principal, if said docks are completed.

That situated as Limerick is, the completion of its harbour is of the greatest importance to the whole trade of the River Shannon, both above and below Limerick, for a navigation of near 300 miles.

Your Memorialists, therefore, pray that your Lordships will be pleased to approve the loan above sought, and to direct the Board of Works to advance a sum, not exceeding 40,000*l.*, for the completion of the floating dock and improvement of the harbour at Limerick, according to the original plan laid down by Mr. Rhodes, under such stipulations, and in such manner, as to the said Board shall seem advisable.

To the Lords Commissioners of the Treasury.

No. 83.

No. 83.

Randall and Williams, on damage to vessels by Gale on the 26th Jan., 1842.

Messrs. RANDALL and WILLIAMS, *on Damage to Vessels during a Gale on the 26th January*, 1842.

GENTLEMEN,

In conformity with your request, we have inspected the shipping at the quays, and we herewith present a report of the several damages, which, at this short notice, we have been enabled to collect:—

"Eclair." Fore-mast and bowsprit gone; bow stove in; and other damage.
"Borneo." Cutwater carried away; stern and starboard bow damaged; fore-mast damaged.
"Atlas." Much chafed and damaged in upper work; bulwarks and stanchions gone.
"Raven." Much chafed; keel supposed damaged.
"Alarm." Windlas upset, and wales and top sides damaged
"Messenger." Upper works chafed and damaged.
"Thomas Tattersall." Upper work and binds damaged; stanchions and bulwarks carried away.
"Pelham Clinton." Stem stove in, and hull much damaged.
"Cygnet." Stem stave in, and otherwise much damaged.

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Randall and Williams, on damage to vessels by Gale on the 26th January, 1842.

"Defiance." Cutwater, bowsprit, and catheads carried away; bends and tops greatly damaged.
"Anna Maria." Bends much chafed.
"Ant." Quarter stove in.
"Effort." Stem stove in; larboard bow stove; and general damage in hull.
"Beer and Wingett." Bowsprit carried away; cutwater and figure-head gone; stem stove in; and general damage.
"Catherine." Bowsprit and stem stove in, and hull damaged generally.
"Rambler." Larboard side much chafed.
"Dahlia." Cutwater gone; stem started; and other damage.
"Mirairy." Bowsprit gone; rigging damaged; and hull much chafed; boats destroyed.
"Jessie." Upset, and hull much damaged.
"Rhodes." Cutwater gone; bowsprit in; and other damage.
"Betsey." Stem and bows stove in; and other damage to hull, spars, and rigging.
"Truant." Hull seriously damaged; and rigging cut, &c.
"Sampson." Hull greatly damaged.
"Wasp." Stem and quarters stove in; mainmast damaged; and rigging cut.
"Liberty." Upset, and lies sunk in the middle of the river, supposed to be greatly injured.
"Marion." Hull greatly damaged.
"Abby." Starboard bow stove.
"Hebe." Quarter and stem stove in.

In addition to the above, scarcely a single vessel escaped damage; several turf-boats sunk along the quays, and boats smashed to pieces.

WILLIAM RANDALL.
GEO. G. WILLIAMS.

To the Limerick Bridge Commissioners.

No. 84.

MR. OWEN, C.E., *on Damage done during a Gale on 26th January*, 1842.

No. 84.
Owen, on damage done by Gale on the 26th Jan., 1842.

SIR, *Limerick, 26th Jan.*, 1842.

I REGRET very much to state that this port was visited with an awful gale of wind last night, and continued up to 11 o'clock with unabated violence. Much damage is done. The whole of the parapet of the south side of Wellesley Bridge and cornice is knocked down by a brig, named the "Rhodes," which was lying on the north strand; she broke away from her mooring, and her bowsprit struck the collector's house and nearly demolished it, and then ran along the bridge carrying everything before it; the arches are not injured. (Two o'clock.)

I am just come in again, and the storm is still very violent and threatens to be as bad as ever. There are three vessels abreast across the first arch of the bridge. I have caused them to be moored as well as can be done, but the captains have decided upon scuttling the outside vessels, should the gale continue, to prevent mischief to themselves or the works. On the north side three of the mooring-posts started, but all the others are standing well.

I have employed 20 men and a foreman upon my own responsibility, removing the turned balustrades, coping, lamps, &c., so as to prevent more mischief being done to them, as many will do again.

The tide is not out, and I fear much damage will be done at next high water.

The banks belonging to Lord Lansdowne and others are very much injured; but I am happy to inform you that the portion belonging to the Bridge Commissioners, as yet, has received little or no damage.

I shall watch closely everything connected with the works, and prevent as much as possible mischief being done.

I hope the Board will sanction my employing the people I have, as much valuable property was in danger.

The Commissioners meet to-morrow, and I will, with as little delay as possible, transmit an estimate in detail for the necessary repairs of the works; but I would now take the liberty of strongly urging the propriety of constructing a floating timber fender or a chain, to prevent the recurrence of such an accident. In 1839, the bridge suffered very considerably from vessels running against it.

I have, &c.,
WM. H. OWEN.

H. R. Paine, Esq.,
&c. &c.

P.S. I have given direction to my man to erect a temporary railing to protect the public.

No. 85.

Relative to Damage done during a Gale on the 26th of January, 1842.

No. 85.
Roche, on the Gale of 26th Jan., 1842.

Limerick Bridge Commissioners' Office,
27th January, 1842.

Sir,

Our engineer, Mr. Owen, having laid before the Commissioners a copy of his letter to you, of yesterdate, conveying a very brief sketch of the damage the works have received from the shipping during the dreadful storm which visited the harbour yesterday morning; and a sub-committee from this Board having been appointed to examine and report, as nearly as may be practicable, the particulars of the several damages which have been sustained by the shipping at the quays, and which report is herewith transmitted for the information of the Board of Public Works; I am directed to address you that you may lay the case before them, and request one of their body would be pleased to come down and examine fully into the subject; feeling, as the Commissioners here do, the every-day liability of such a calamity (this being the second and much worst) again occurring in the present unprotected and dangerous state of our harbour. In the mean time they have directed Mr. Owen to

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No. 85.

Roche, on the Gale of 26th Jan., 1842.

prepare estimates for repairing the damage, and take the necessary steps for protecting the works and the public crossing the Wellesley Bridge.

The Commissioners beg once more strongly to urge upon your Board the glaring fact that every year our works and shipping sustain a pecuniary loss, perhaps equal to the cost of an effective preventitive; and I am further instructed to state, that there is no certainty that within one week the same lamentable occurrence may not again take place. We are probably the most unprotected port in the kingdom, and the shipping interest are anxious and willing to pay such additional rates as provided for in their Act of Parliament, which, in the opinion of the Bridge Commissioners, would form a revenue more than equal to the required expenditure.

The Commissioners further desire me to express their regret that it did not come within Mr. Owen's province to report the damage sustained by the shipping, as detailed in the accompanying report.

I have, &c.,
J. ROCHE, *Secretary*.

H. R. Paine, Esq.,
&c. &c.

No. 86.

No. 86.

Memorial of Limerick Bridge Commissioners, 1843.

The Memorial of the Limerick Bridge Commissioners.

Limerick, April, 1843.

HUMBLY SHEWETH—That in consequence of the great inconvenience for a long time experienced by the inhabitants of the county of Limerick and county of Clare, in having no communication across the Shannon at Limerick, but by the very old and narrow bridge called Thomond Bridge, and accommodation being also much needed for the increasing number of vessels trading to the port of Limerick, in the year 1823, your Memorialists applied for and obtained an Act of Parliament (4th Geo. IV. chap. 94), by which they were incorporated under the name of the Limerick Bridge Commissioners.

That by said Act your Memorialists were empowered to erect a stone bridge, with one or more swivel bridges adjoining thereto, over the River Shannon, below Thomond Bridge, and also to construct a canal or still-water navigation on the southern side of said river, and to apply such navigation to the purposes of a floating dock, by the erection of such piers, quays, gates, and walls, as should be requisite for said purpose.

That, in order to effect these works, your Memorialists borrowed from the Loan Commissioners the sum of 80,384*l.* 12*s.* 4*d.* in two separate loans, and which sums were expended in building the bridge, and in constructing the necessary avenues thereto, but were not sufficient to complete any part of the still-water navigation, or afford any benefit to the trade of the port, although it was obliged to bear the whole of the taxation levied for the purposes of the Act.

That, when so much of the said works had been completed as the funds placed at your Memorialists' disposal were adequate to, and it was ascertained that the whole sum which they were permitted to borrow by the said Act would be altogether insufficient to carry out one of the principal objects contemplated therein—namely, the providing a safe and commodious harbour for the shipping; and that in consequence of the great and unforeseen increase in the trade of the port during the time the first part of the works was in progress, it was found that the erection of the bridge, and the partial construction of the proposed still-water navigation, had not only created an impediment to the free passage of vessels to the upper quays, but had also limited the whole extent of quay room so much as to render what remained quite insufficient for the accommodation of vessels frequenting the port in loading and discharging their cargoes.

That your Memorialists, in consequence, applied to Government to afford them means to complete the works originally contemplated, as affording the only remedy possible to prevent serious loss and injury to the trade.

That Mr. Rhodes was thereupon directed by Government to survey and report on the harbour of Limerick, in connection with his general survey of the River Shannon; and in his report he recommended a plan extending the original design of your memorialists, but at the same time one which was calculated to confer a very great benefit on the port, inasmuch as it contained a provision for a still-water floating dock, capable of affording shelter and accommodation to the whole of the shipping within the port.

That in order to secure so great an advantage, and to meet the views of Government, as laid down by Mr. Rhodes, your Memorialists applied for a second Act of Parliament grounded on his plan, and with so full an expectation that they should obtain sufficient funds from Government to carry the whole into effect, that they consented by said Act to make a very considerable addition to the taxes already imposed on the trade, for the completion of the original works.

That the 9th section of said Act (4 and 5 Will. IV. c. 84) specified the works it was intended to undertake, and of which plans and sections were deposited in the Private Bill Office, in the House of Commons, and in the Parliament Office of Westminster, and to which your Memorialists beg leave most respectfully to refer.

That, as empowered by said amended Act, your Memorialists proceeded to borrow from the Commissioners of Public Works the further sum of 45,000*l.*, with part of which they were first obliged to purchase various lands, tenements, grounds, and hereditaments, lying alongside or adjoining the River Shannon, and the possession of which it was necessary for them to secure, in order to carry out the plan of Mr. Rhodes; and in such purchases they were obliged to expend the sum of 29,438*l.* 9*s.* 8*d.*, leaving them only 15,561*l.* 10*s.* 4*d.* to provide for the erection of the quays on the south side of the river, and the sewers in the said quays, being the first part of the works which your memorialists are obliged to complete by the provisions of the Act, and which works are now in progress.

That, although by this last expenditure much accommodation has been afforded to the shipping in loading and discharging their cargoes, there remains still much to be done, in order to secure the safety of vessels lying at the quays during the prevalence of westerly winds; as a proof of which, your Memorialists beg to state that, during the last two winters, damage to the amount of over 12,000*l.* has been sustained by vessels alone, and considerably above that amount in the injury and destruction of goods and merchandise laden on board those vessels at the time.

That your Memorialists respectfully submit, from their own experience, and that of the whole trading interest of the port, backed as it is by the lately expressed opinion of Mr. Rhodes himself, that however great the benefit to be derived from the completion of the intended quays at the south side of the

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river, in giving room and accommodation to vessels, there can be no proper means of securing them from frequent injury and loss but by the full completion of the plan originally contemplated, of forming a pier or wall across the river below the city, in order to provide a floating-dock for all the vessels at any time within the port.

That, in order further to account to your Lordships for the urgent necessity existing for extended accommodations to the port of Limerick, your Memorialists beg to state, as a proof of the increased trade to the port, that the income of your memorialists arising from the duties on imports, exports, and tonnage levied under the Act, which for the first year they were in operation, ending August, 1824, amounted only to the sum of 1,080*l.* 15*s.* 10*d.*, has amounted, during the year ending 31st March, 1839, to 3,724*l.* 8*s.*; and, as a further confirmation of this increased trade, they beg also to state that the custom duties of the port of Limerick, for the year 1824, amounted only to the sum of 61,908*l.* 9*s.* 10½*d.*, while the amount for the year just elapsed, notwithstanding the repeal in the interim of the duty on coal, salt, and other goods, and the reduction in the duty on tea, sugar, &c. &c., has reached the sum of 148,782*l.* 0*s.* 8*d.*—showing the great advantage to the revenue likely to arise from affording such protection to vessels as will still further foster and promote the rapidly increasing trade of this port.

That the present income of your Memorialists, arising out of the duties levied on the imports and exports of goods, and the tonnage of vessels entered at the port, amounts, as already stated, to 3,724*l.* 8*s.*; but by the provisions of the second Act of Parliament herein referred to (4 and 5 Will. IV. c. 84), as will appear by referring to the schedule thereto, these duties will be so much increased, as soon as the whole accommodation sought for by your memorialists is obtained, that the said income, without any further increase of the trade, will be nearly doubled, and therefore afford an additional security for the repayment of what further sums may be necessary to complete Mr. Rhodes's plan of making a floating-dock at Limerick.

That, although the sum of 29,438*l.* 9*s.* 8*d.* has been expended in the necessary purchase of lands, tenements, and grounds lying adjacent to the river, yet a part of these being at present let, yield a net income of 384*l.* 9*s.* 1*d.*; and when the whole of the works are completed, the most valuable part of these lands may be made so productive as to yield an income fully proportioned to the whole outlay thereon; so that your Memorialists conceive there cannot be the slightest doubt of there being full security for all further sums required for the most perfect accomplishment of Mr. Rhodes's plan.

That your Memorialists beg further to submit that, in consequence of the Act of last session for the improvement of the River Shannon, the trade of Limerick, as an outlet, is likely to be still further increased; and your memorialists conceive that, to give due operation to said Act, and to carry out fully the intentions of the Legislature, it will be necessary to afford every accommodation and protection to the harbour of Limerick, as the emporium of a large agricultural district, the centre of the extensive commercial operations of five counties, and, above all, as the only port in the Shannon.

That your Memorialists beg also to state that, in the Act of last session for the improvement of the River Shannon, provision has been made for the improvement of every locality in said river, both above and below Limerick, from its source to its mouth, excepting the most important—the port of Limerick; and which exception may, perhaps, have arisen from the supposition that Limerick was already provided for by the two Acts of Parliament already referred to, without taking into consideration that the trade of Limerick had voluntarily submitted to a very heavy taxation in the hopes of obtaining the benefits proposed by said Acts.

That by the completion of the works proposed by Mr. Rhodes, which would render Limerick a safe and commodious harbour, with ample accommodation for every description of vessels, new sources of trade would be opened which cannot exist at present; and, advantageously situated as Limerick is, there is no doubt that in a few years the trade to North and South America, and the West Indies, as well as other distant countries (and which is carried on in a description of vessels that cannot now venture to visit this port with safety), would amply repay, by the increased amount of the revenue, the additional outlay now sought for by your Memorialists.

> Your Memorialists, therefore, pray that your Lordships will take into consideration the present situation, prospects, and capabilities of the port of Limerick, with a view to its adequate protection as a harbour, as a part of the great object proposed in the general improvement of the River Shannon, and the accomplishment of which can alone complete and give full effect to that great national undertaking.

To the Lords Commissioners of the Treasury.

No. 87.

Rhodes and Owen on the proposed Docks at Limerick.

No. 87.

Report by Messrs. T. RHODES and JACOB OWEN, *on the proposed Docks at Limerick.*

SIR,

Limerick, 1*st October*, 1843.

Pursuant to the directions of the Bridge Commissioners, as communicated in your letter of the 12th ultimo, we have proceeded on the examination of the several objects adverted to in your letter, and required by the recent Act of Parliament for the further improvement of the port and harbour of Limerick.

Our attention has been particularly engaged in examining how far the proposed measure of constructing a weir across the river at Kelly's Quay is likely to affect the four mills mentioned in the Act, viz., Corbally and Lock mills, Curragower and Golden mills; and we have to report, with reference to the two latter, that their entire removal, including the weir across the river, is comprehended in the project, and consequently the proprietors will be entitled to compensation for the property, the amount to be ascertained by a jury empannelled for the purpose; with a view to which, we have deemed it expedient, with the assistance of Mr. Steel, an experienced millwright from Cork, to take an accurate account of the power of these mills, and the present state of the machinery and buildings, with such other data as are necessary to show the value of the property: they are, however, mills of small power, each having only one water-wheel. Golden mill is in a dilapidated state, and worth but little beyond the value of the water power; but that of Curragower has been recently rebuilt from the ground floor, and the machinery renewed. It is proper, however, to observe, that in the proposed project sites for two mills are contemplated, which will be adapted for mills of larger capacity than those of Curragower and Golden mills.

We have also made accurate observations for several successive days, as to the height of the water at Corbally and Lock mills, when it shall be at the level at which it is proposed to be raised by the

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Rhodes and Owen on the proposed Docks at Limerick.

intended weir, and we found both of them at work without obstruction, when there were 16 feet of water on the sill of Wellesley Lock, and at the same time a very considerable current in the river; from this circumstance it may reasonably be inferred that these mills will sustain no injury, and in this opinion Mr. Steel concurs, as will appear from his report, which we have annexed hereto. We feel it right, however, to observe, that in the examination of these mills, we perceive there might be a considerable improvement made in discharging the water from the tail-races, by straightening and widening the courses, and protecting the sides by retaining walls, paving the bottom, &c., and we are of opinion that these improvements should be made at the expense of the commissioners. But notwithstanding it appears that the mills in question will be subjected to no material injury, we are of opinion, after a careful consideration of the subject, that all the purposes of this important measure will be accomplished if the top of the weir were limited to 14 instead of 15 feet, as originally intended; this height, it would appear, will afford sufficient depth of water for the class of vessels that usually resort to the port; and to provide for those of a larger class, we would recommend that the south lock be increased two feet in depth, and that a certain portion of the dock in mid-channel (where the water is already deep enough for the purpose, or can at a small expense be rendered so), should be appropriated for the larger class vessels. This height will give a depth of from 14 to 15 feet of water in the dock (besides the increased depth for larger vessels already adverted to), varying according to the quantity of water flowing down the river, which will cause the height above the top of the weir to fluctuate. By adopting this reduced height, the possibility of injury to the Lock mill, and that at Corbally, is not only completely removed, but the projected measure, with the improved construction of Thomond Bridge, will be productive of important advantages to those mills.

The next object which has engaged our attention, pursuant to your instructions, has been that of taking the necessary levels, to ascertain whether any of the streets or buildings of the city are likely to sustain any injury by having the drainage impeded, and we find that the lowest street is so much above the proposed surface of water in the dock, as to afford ample fall for drainage, and that the apartments in the basement of the houses on Arthur's Quay are about two feet above the intended water level in the dock, and are also sufficiently high to admit of the floors being raised further to increase the height, if it shall be deemed necessary to do so, and indeed, it would be of considerable advantage to the occupants if it were done, without having reference to the present measure; but if the Bridge Commissioners should approve of diminishing the height from 15 to 14 feet, as we recommend, it will be productive of advantage with regard to the drainage, both in the city and in the lowlands of Corbally; and, in any case, in building the quay walls, it will be absolutely necessary to construct a very capacious sewer, at a proper depth, so as to afford an efficient drainage for the present or any future circumstances that may arise in the city, the necessity for which was foreseen by Mr. Rhodes, and the expense provided for in his estimate for the works.

The Act also provides "for the free passage of all vessels to and from the quays of the said city during the progress of the work," which object may be secured without difficulty, by first building the locks, during which period the centre of the river will be open for the passage of vessels, and when these shall have been completed, they will afford the means of vessels passing them, while the weir is proceeding, in the same manner they at present pass the Wellesley Dock.

We feel it proper to state in conclusion, our decided conviction, on a review of all the matters that are involved in the consideration of this subject, that it is a project which appears well adapted for all the purposes that were originally contemplated by the measure, and that it will eventually be productive of important advantages, not only to the city and port of Limerick, but to a large portion of the west of Ireland.

We have, &c.,
THOMAS RHODES.
JACOB OWEN.

John Roche, Esq.,
&c. &c.

GALWAY.

No. 88.

Evidence taken on the 20th Sept., 1845.

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PORT OF GALWAY.

Examining Commissioner—Capt. WASHINGTON, R.N., F.R.S., assisted by Capt. BEDFORD, R.N., Admiralty Surveyor.

Present:—Lord WALLSCOURT; P. M. LYNCH, Esq., High Sheriff of the Town; THOMAS N. REDINGTON, M.P.; A. H. LYNCH, Master in Chancery; J. H. BURKE, St. Clernes; LACHLAN MACLACHLAN; ANTHONY O'FLAHERTY, Knockbane; J. IRELAND; MARTIN MORRIS, Lenahoy; ARTHUR IRELAND; DENIS CLARKE; JAMES FYNN; JOHN BLAKENEY; ROBERT D. PERSSE; Captain WHITE, R.N., Inspecting Commander of Coast Guard; Capt. BEDFORD, R.N., Surveyor to the Admiralty, with his Staff of Assistants; Captain MOORE, R.N., Harbour Master; HENRY BLAKE; ANTHONY RENVILLE; J. H. BATH; J. STEPHENS; T. MURRAY; Mr. HOOPER, Chief Officer Galway Coast Guard; H. TOWNSEND, &c.

Mr. JAMES FORBES, examined.—Assistant Secretary to the Harbour Commissioners. Is aware of the letters and accounts transmitted to the Secretary of State relative to the Harbour Board of Galway; they were in his handwriting, and correct. The number of Harbour Commissioners is 63. Produced the governing Act for the Port of Galway, known as the Harbour Act; it received the royal assent on the 17th of June, 1830, and pointed out the sections which referred to the number and qualification of the Harbour Commissioners. An amended Act for extending and enlarging the Docks was procured on the 23rd of August, 1831.

In case of vacancy the Board itself fills it up. The shipowners have no voice in the election. Each meeting appoints its own chairman. The Commissioners direct the harbour master and the other officers in their duty. In the letters forwarded to the Secretary of State there was no mention made of complaints received against the state of the harbour, as none were made.

Mr. TOWNSEND said that several complaints existed as to the bar at the entrance of the New Docks.

Mr. FORBES.—Yes; there were complaints of that kind, but they were sent to the Board of Works. Several complaints were made as to the bar outside the Docks. The Commissioners wanted the bar to be sunk to enable ships to come in at neap-tides, and the memorials on the matter were transmitted to the Board of Works.

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The CHAIRMAN remarked that it was in dispute that the contractor for the building of the New Docks had not fulfilled his contract in leaving the bar at the entrance.

Mr. TOWNSEND said that he, on the part of the ship owners, had forwarded a memorial to the Board of Works to have the bar removed. The Board appointed Mr. Coneys, C.E. to investigate the matter, but they had heard nothing of it since.

Mr. FORBES handed in an abstract of the accounts. It was the custom for the Commissioners to appoint two of themselves to audit the accounts previous to the receipts being placed in the hands of the Board of Works. The average revenue of the dues for the last ten years was about 1200*l.* per annum. The Docks have not been completed yet, the entrance-channel not being finished. An item in the accounts of 793*l.* for repairs of the dock-gates was owing to their being put out of order by ships knocking against the sides in consequence of the bar. The gates are now constructed on a plan quite different from the first.

Mr. REDINGTON, M.P. said, as he understood, after the Act for building the New Docks was procured, a contract was entered into for the purpose; and the money being had from the Board of Works, under whose directions the Docks were constructed, the property was mortgaged to them, and they now stood in the position of contractors and mortgagees.

Mr. STEPHENS explained that the gates originally put up were not on the best plan, nor the materials the fittest for the purpose; they were erected under the sanction of the Board of Works by the Harbour Commissioners, but the 793*l.* afterwards expended on their repair put them into a proper condition.

COMMISSIONER.—From the accounts it appeared that in one year one-sixth of the income was expended in salaries, and the remainder on improvements relative to docks made but three years before.

Mr. MACLACHLAN said the management was then in the hands of the Board of Works.

Mr. FORBES stated the annual income of the Board. In August, 1831, the tolls were sold for 700*l.* From 1831 to 1842 the sale averaged 1200*l.* per annum. In 1842 they were sold to Mr. Sloper for 1275*l.* In 1843, the Board of Works being then in possession of the tolls, and the dock-gates undergoing some repairs, and thinking it more profitable to collect the tolls themselves, they directed Mr. D'Arcy to have the tolls collected, which he did accordingly, and for the year ending the 5th of August, 1844, they produced the sum of 1608*l.* 17*s.* 4*d.* net. The Board of Works seeing the advantage they had on that year's collection, directed Mr. D'Arcy, with the consent of the Harbour Commissioners, to continue the collection, and the tolls brought from 5th of August, 1844, to 5th of August, 1845, 1962*l.* 9*s.* 11*d.* net, or about 2100*l.* gross. The amount of the debt at present due to the Board of Works amounted, he believed, to upwards of 21,000*l.* They had the best prospects of paying it off. The dues at first were, as he stated, but 700*l.*, but they rose afterwards to upwards of 2000*l.* 5 per cent interest was paid on part of the debt.

Mr. IRELAND.—What we owed on the 31st December, 1844, was 22,757*l.* 5*s.* 4*d.*, including principal and interest. There were three loans granted—one of 17,000*l.*, one of 4000*l.*, and one of 3000*l.*, altogether amounting to 24,000*l.*

Mr. STEPHENS called attention to a copy of the Report of the Commissioners on the subject of Harbours of Refuge, and also to the following statement of Loans made by the Commissioners of Public Works to the Galway Harbour Board, under the 1st and 2nd Will. IV. c. 33, and subsequent Acts, showing the original amounts issued in Exchequer bills, or under the 6th and 7th Victoria, c. 44, and the repayments on account up to and ending on the 31st December, 1844.

On the 8th of June, 1832, a loan of 17,000*l.* was granted for constructing the New Docks. The repayments made on this loan were 4217*l.* 18*s.* 10*d.* principal, and 2938*l.* 5*s.* 8*d.* interest. On the 13th of July, 1837, another loan was granted for the same purpose, and the repayments on this have been 80*l.* principal, and 505*l.* 14*s.* 5*d.* interest. On the 23rd of June, 1838, a further loan of 3000*l.* was obtained for completing the harbour works. On this there has been no repayment of principal, but 151*l.* 4*s.* 6*d.* interest. By this it appears that on the entire loan of 24,000*l.* there were paid, principal 4297*l.* 18*s.* 10*d.*, and interest 3595*l.* 4*s.* 7*d.* Total repaid, 7893*l.* 13*s.* 10*d.*, still leaving due on the 1st of January, 1845, 22,757*l.* 5*s.* 4*d.* on the original loan of 24,000*l.*

No account of the expenditure has been submitted to the Commissioners, since the Board of Works took the management into their own hands.

COMMISSIONER.—As Harbour Commissioners they were bound to investigate their accounts, and it would be desirable to publish them for the satisfaction of shipowners and others interested. In Glasgow and other ports the accounts were always published, for there was nothing so much calculated to render public bodies efficient as the influence of public opinion. If public opinion had had its due influence in the original construction of the Docks, it is probable that no expenditure would have been afterwards incurred for the repair of the gates. It is to be regretted that no accounts were furnished to the Board; and no jurisdiction of the Board of Works could exonerate them as Commissioners from complying with their Act of Parliament; and had the accounts been properly applied for no doubt they would have been furnished.

Mr. R. D. PERSSE stated that the Board of Works did not consult them at all. They expended 100*l.* when making the gates in constructing a breakwater with India-rubber and a few boards, which was swept away, and he thought they ought to be called on to refund that sum to the Commissioners.

Capt. JOHN MOORE, examined.—Is a Commander in the Royal Navy and Harbour Master to the port since 1830, when the Act was procured. Is not generally acquainted with the Galway Bay, only the harbour. Great improvements have been made in the Docks these fourteen years, except as to the bar at the entrance. Fourteen years ago the harbour was in a very bad state; the old pier, now standing, was prostrated with the beach, and several breaches were made in the walls inside the Old Docks. From time to time they lifted several rocks which projected about 14 feet outside into the river, got them up to repair the quays, and thus continued until the New Docks were built and got possession of in 1841. In consequence of the state of the harbour, it was decided in 1832 to build New Docks, and the Commissioners got an Act for that purpose. At low water spring-tides there are two, two-and-a-half, and sometimes three feet depth of water outside the gates. The bar is a complete rock, and runs directly across the entrance from east to west: there were likewise some flats outside the bar. Understands the contractor was bound to

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excavate the entrance out to the pool, but it has not been done. Mr. Bucke was then the engineer; there is no engineer at present to the port.

Mr. STEPHENS said the impression of the Commissioners was that the bar should be deepened five feet under low water-mark. The plan of Mr. Killaly, Engineer to the Board of Works, was to have the Dock five feet under the level of low water-mark of ordinary spring tides, and to be dredged out to low water-mark in the pool to the same level; but though Messrs. Henry Mullins and M'Mahon contracted to do it, it has not been done up to the present hour, inasmuch as a bar has been left outside two feet ten inches above the sill of the dock-gate, and which has been the cause of much injury to shipping entering the harbour. Mr. Killaly's plan also contemplated the making of the Docks deeper than the outside, to allow ships of large burden to drop down, while smaller ones were getting out at neap tides.

Captain MOORE.—The engineer kept up a superintendence while the works were going on. No steps have been taken to remove the bar; it is extremely prejudicial to the interests of the harbour. One vessel broke her back upon it, and the owner got 500*l.* or 600*l.* as compensation.

Mr. TOWNSEND said that the bar caused a loss to him of 300*l.* by damage done to his ship '*The Lively*,' and the property in her was also injured very much: other shipowners likewise suffered.

Captain MOORE thought about 500*l.* would remove the bar. There was three feet difference between the sill of the gates and the bar. Several ships have been injured by it. I think that it would be for the interest of the shipowners of the port themselves to subscribe for the removal of the bar, leaving the dispute with the contractor to be settled hereafter.

Mr. IRELAND said it was right to mention that by the original contract the entrance channel was to be made 60 feet wide, but that was since found not to be wide enough.

Captain MOORE.—The depth of water that would bring a ship over the bar would bring her over the flats outside. The sill of the dock-gates was about 18 inches below low water at spring tides. There is a tide scale on the dock-gates. The zero is on a level with the top of the bar.

Captain BEDFORD, R.N., said that the lock sill was, according to his gauge, three feet below low water-mark.

Captain MOORE thought nine inches of water would be on the sill at low water if the bar were removed. Vessels deeply loaded inside the Docks could not sometimes get out, as the inside is deeper than the outside.

Mr. J. H. BURKE, of St. Clarens, said everything was done by the engineer in Dublin; the Commissioners had nothing to do with it.

Mr. STEPHENS.—Mr. Nimmo's plan of a dock and tide basin was that upon which the Harbour Act was procured; and the Commissioners having sent a deputation, of which he was one, to Dublin to the Board of Works, they submitted Mr. Nimmo's plan to them in order to obtain a loan for the building of the dock; but the Board declined lending on Mr. Nimmo's plan, on the ground that it was too expensive, and obliged the Commissioners to borrow on the plan of Mr. Killaly, the Board's own engineer, which reduced the original plan considerably.

The Harbour Commissioners had no alternative but to adopt the plan of the Board of Works, as the Commissioners would not otherwise get the money.

Captain MOORE.—At extraordinary tides, ships of 700 tons' burthen might enter. The width of the gate was 56 feet.

The area of the docks is about five acres, and when the gates are closed, from 13 to 14 feet depth of water is in the basin. The works of the quays are in good condition, except on the east part, where the masonry is indifferent; knew a light ship in a gale of wind to knock some of it away. Ships lie easy in the basin; more mooring posts would be required. There is an old dock of no use, but for turf-boats. There are two very fine piers at Claddagh, which were built partly by subscription, and partly by a grant from the Fishery Board; besides, there is Nimmo's Pier. There is a flat which extends from Nimmo's Pier to Hare Island. No attempts are made at dredging, though a dredging-machine would be very essential. There is a reef of rocks to the east of Nimmo's Pier, called Renmore Point; and if a turn-water were there constructed, and the channel kept dredged, the entrance to the docks could be kept clear. If that flat were excavated, it would not fill again. He suggested no improvements to the Harbour Board, as there were no funds. He showed the reef of rocks at the entrance, and the breaches in the old dock, to General Burgoyne, one of the Commissioners of Public Works, but nothing was done. In a gale of wind, the fishermen run for shelter into the old dock. The fishing-grounds of the bay extended out as far as 30 miles. Greater accommodation would be given the fishermen, if a safety harbour were constructed 15 miles or so lower down the bay. If a breakwater were constructed from Mutton Island to Fairhill, it would be the means of great safety to vessels and boats in a westerly wind; an abundance of material is on the spot for the purpose.

Mr. TOWNSEND said, that unless the course of the water from Lake Corrib were changed, a breakwater would choke up the entrance to the docks, as a strong current ran from Oranmore Bay out towards Mutton Island.

Captain MOORE denied there was such a strong current. The river brings down a quantity of gravel, which lodges in the pool at the east of the entrance to the docks; it is never removed. In his opinion, a breakwater would be required from Fairhill to Mutton Island: ships scarcely ever drive from their anchorage on the roads.

Lord WALLSCOURT said, he saw himself six vessels driven away in one night.

Capt. MOORE saw four vessels driven away, but it was at an extraordinary tide on the night of the great storm, he believed in 1839. Keeps no log of the winds or wrecks which occur in the port. The driving was not the fault of the holding-ground, but of the tackling giving way. The breakwater, if erected, would have kept them from driving. A heavy sea sets in from the S.W. If a pier were built out from Mutton Island, S.S.E., where there would be from five to six fathoms of water, it would afford great safety to vessels in a westerly wind. The holding-ground all along the bay is particularly good. The height of the light on Mutton Island is 33 feet above the level of high water, and is thought to be too low; often heard masters of vessels complain it was too low, but no complaints were to that effect forwarded to the Ballast Board. In a clear night the light

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would be seen from Blackhead, about 10 miles distant. Heard no complaints of the light on Arranmore. Had no knowledge of embankments up the river. There is a salmon weir across the river, but the tide does not go up to it; it gets up as far as the West-bridge, and sometimes stops the working of the mills there; it never flows above the West-bridge. A strong current comes down with great force, and sometimes interferes with ships getting into the docks.

Capt. HUGH BRICE WHITE, R.N., examined.—Is a captain in the Royal Navy, inspecting commander of this port, and is acquainted with it these 18 years. Great improvements have been made in it since then by the building of new docks; the old one was very bad He always thought the roadstead particularly good. The holding-ground is excellent in every place within the islands of Arran, which form a natural breakwater to the bay. There is no difficulty in passing through either the north or south channel of the Arran islands; the North Sound is nearly five nautical miles wide, and the South about four. There is no difficulty in heavy gales from the westward for ships goining entrance to the bay; has seen ships in the centre of the bay, 10 miles down, ride out in very heavy gales of wind. In every part of it there is excellent anchorage for men of war; knows five ships of the line to have anchored at Blackhead within the bay.

The HIGH SHERIFF said that in 1794 he recollected to have seen in it 19 sail of East Indiamen, which remained for some weeks, until a 74 arrived to convoy them to their destination; he was too young, however, at the time to visit them.

Capt. WHITE.—There is no reason that the largest fleet in England should not anchor in Galway Bay. No heavy swell from the Atlantic comes up the bay, as the islands of Arran act as a breakwater to prevent it. There is no difficulty in making the bay on account of fogs; I have seen but very few of them here: I am in the habit of keeping a journal, and do not recollect to have seen more than two fogs in the bay these 18 years.

I did not not allude to hazy weather; I only spoke of what are known as thick fogs.

There is nothing in my experience as a sailor to induce me to think there is a difficulty in making the bay in foggy or hazy weather.

The light at Arran is perched too high; it is 413 feet above the level of the sea. Captains of vessels often see the rocks before the light. The lighthouse is painted white, and the light is a revolving one. Has seen vessels drive twice from the roadstead, but not on account of the holding-ground; it was owing to their not giving sufficient cable, and making themselves snug. Was always of opinion that if a harbour were erected about half a mile in a south-east direction from Mutton Island, it would be of the greatest advantage, and the roadstead will never be complete without it; that would make it sufficiently safe, for there is a good depth of water there; the lead in the bay gradually shows the approach of the vessel to land. Thinks if the light at Mutton Island were higher perched, it would answer better; masters of vessels complain that it is too low. Does not think that a breakwater between Fairhill and Mutton Island would be of great consequence to vessels, unless at high water; it would be useful as a means of communication. Does not see why Galway should not become a port of the greatest commercial importance; it has the finest outlet in the world to America, and one of the noblest bays. Has seen the *Cyclops* war-steamer, which draws 17 feet of water, lie inside of the roads; the *Stromboli* also, with other large steamers. Has heard that railways are about to approach the port of Galway, and it is likely, if constructed, they will greatly increase its traffic. Thinks the port, in its present state, suited to that traffic. The docks, he believed, were sufficiently extensive.

Relative to the bar, Mr. Townsend called on him once to show him two ships that lay on it, and if it happened to blow from the southward at the time, these ships, with the property on board, would have been lost; believes the property in them at the time was worth about 3090*l.*, and thinks that 300*l.* would be enough to have the bar removed. Mentioned the matter to the Harbour Commissioners, and also to the chairman of the Board of Works. Sufficient attention had not been paid to the boats, which were permitted to heave out their ballast in every direction.

The HARBOUR MASTER stated that that was the case some time ago, but not at present. Some of the boatmen were punished for doing it; 40*s.* fine was imposed on each of them; and when they found that they would be thus prevented, they gave up the habit.

Capt. WHITE.—Thinks the basin of the new dock equal to ten times the present traffic. The bay was one of the finest sheets of water in the world, and the finest outlet for communication with every part of America by steam. If the harbour outside of Mutton Island were constructed, the port would be complete.

If a pier were run out, there would not be any deposit.

Between Mutton Island and the mainland, I have seen no difference in the depth of water these 18 years. There is scarcely any current between Mutton Island and the port. The piers within the bay have always been in an unsafe condition.

Keeps a register of the fishing-boats. The fishing ground from Mutton Island extends about 30 miles. The want of an asylum harbour causes a great loss to the fishermen; knows them to have been several nights out unable to procure shelter. There is a place called Greenbanks, or Awleen, about a mile and a half beyond Spiddle, which could be made a splendid asylum harbour for about 3000*l.* Thinks if a portion of the fishermen were removed there, it would be of vast advantage to the town, the fishery, and even the fishermen themselves. Has heard that a good many of them would be willing to go there.

The fishermen of Galway are a well-conducted, hardy, and laborious people.

The same harbour would be of great advantage to the turf-boats, as many of them are injured for the want of it. On the 23d of April, 1841, a large number of hookers were lost in the bay in a gale of wind, not having an asylum harbour to run to. There are 2000 fishing-boats, hookers, and yawls in this district, manned by 16,000 men.

That is a large number of men, whose interests should be carefully looked after; they are as fine a race of young men as any in the world, and would be great advantage for recruiting the British navy. I pointed out the want of a harbour of refuge to the late Mr. Nimmo, and to Mr. Barry, one of the inspectors of the Fishery Board. The pier at Spiddle was constructed in 1821, but is not of the slightest use to the fishermen. A harbour could be constructed at Awleen at a trifling expense. Spiddle pier is about half way between Galway and Costello Bay, and extending it would be of greater expense than building a new pier at Awleen. Is in the navy about 46 years, and had seen much service during the late wars, and, from his experience as a sailor, was certain there is no difficulty in making the bay of Galway.

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Is not of opinion that it is easier to make other places on the coast. In case of an increase of shipping, a light at the South Sound of Arran might be useful. There is no want of coast-lights since the one erected at Slinehead. The Arran light is between that and Loophead. Between Slinehead and Loophead the distance he did not know exactly, but it is about 50 miles, and the Arran light stands about half way between; thinks that sufficient for the coast. Cushen might be made an excellent harbour of, as it is in his opinion the best on the coast for ships to run into; there is a fine open to it. Is not much acquainted with Clew or Blacksod; but thinks if a harbour were made at Mutton Island it would render Galway one of the finest ports in the empire. Thinks it better to leave Renmore Point as it is.

Thinks the outer part of Nimmo's pier at the entrance of the harbour is in a reverse direction of what it should be; and it would be desirable to have the end of it taken down for the improvement of the harbour.

Lord **WALLSCOURT** pointed out on the chart the position in which he thought the docks ought to have been constructed, instead of where they were, so as to enable them, by changing the course of the river, to fill the basin with fresh water, which would be of every advantage to the shipping, and to convert Lough Athalia into a large floating dock. If the course of the river were changed, it would always keep the channel clear. The docks in their present position, he thought, were altogether on a bad plan.

A dredging-machine also would be most essential to the harbour. It is in general use; even at Venice, where improvement is said to remain stationary, the dredging-machine is used.

The usual means of directing currents, and using dredging-machines, would keep the harbour clear.

Materials are convenient for building a detached breakwater from Fairhill to Mutton Island. Stone is on the spot, and labour could be had at the cheapest rate.

It was contemplated to extend the navigation to Lough Corrib, which would render the port extremely valuable.

Mr. R. M. **LYNCH**.—A company was established called the Irish Great Western Railway Company, whose capital was 1,080,000*l.* for constructing a railway between Dublin and Galway, and which had every likelihood of obtaining a bill for the purpose in the next session of Parliament.

Is a resident of the port of Galway, and acquainted generally with its traffic—had occasion to take the traffic last year to be laid before a Railway Committee of the House of Commons—compared it with the Railways Commissioners tables in 1838—in 1844 the imports were 18,000 tons, but in 1838 only 12,000 tons.

The exports were 26,600 tons, and in 1838 only 20,000 tons, being an increase of over 30 per cent. on the exports between these periods. About ten years ago, the shipping to the port was as low as 84, but since dock accommodation has been afforded, the shipping has increased to 209 or so.

About 10 years ago, 120 tons was the registered maximum size of the vessels visiting this port, but it since had risen to 440 registered tons. In fact, all the vessels have since increased in tonnage and size.

Until the New Docks were opened the harbour was not deemed safe—upon the opening of a railway to Galway, he should think that increased dock accommodation would be required in some years, but he did not think that within their time it would be requisite to turn Lough Athalia into a floating dock.

In case of the improvement of the lake, and the formation of a railway, I think a great part of the inland traffic, which is at present carried to Westport, would come to Galway, and from Clare, by means of steamers. The improvements carrying on in Connemara will add greatly to the imports and exports of Galway.

It might be advantageous to the merchants themselves to improve the port of Galway.

But they should not be expected to construct a breakwater at Mutton Island. Government, I think, should make a grant for constructing breakwaters. We built new docks, at an expense of about 30,000*l.*, and we have paid a great deal of the debt, only 22,000*l.* remaining unpaid.

The charge on shipping in the floating dock, is eight pence per registered ton, and outside the dock six pence per registered ton, which is as much as the Act permits.

I think the Board of Works should have removed this bar.

Captain **BEDFORD**.—Does not the railway company look beyond Galway as a terminus—a communication with America?

Mr. **LYNCH**.—They do.

Captain **BEDFORD**.—In case of American traffic, would it not be requisite to build new docks?

Mr. **LYNCH**.—It might.

Captain **BEDFORD**.—I have myself often seen the present docks filled with shipping.

If Captain Whyte's plan of a dock at Mutton Island were carried out, and a breakwater from it to Fair Hill, it would answer well.

The survey in Galway was ordered merely for the convenience of the war steamers which were appointed to visit the port, and he heard Captain Plunket, R.N., complain that there were no Admiralty charts of the bay to be had.

The **COMMISSIONER** said that Government selected Galway for the commencement of the survey before the steamers visited the port at all.

Mr. **LYNCH** thought the great boon that Galway was looking for was to be made the western packet station with America.

Mr. **JOSEPH EVANS** examined.—Is acquainted with the Bay and Harbour of Galway about 15 years; acts as a ship-broker; was about two years at sea, and acted as deputy to the pilot; never anchored a ship in a gale of wind in any part of the bay.

The bar at the entrance of the dock was very dangerous, and he had often to complain that it was not removed; made no representation of it to the Harbour Commissioners, as the thing was so generally known; the character of the port suffered materially from it.

JOHN QUINN.—Is acquainted with the Bay and Harbour of Galway these 40 years, in the fishing line, and besides has been 18 months leading man in taking the soundings of the bay for Captain

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GALWAY.

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Bedford; the anchorage is good, except in a very few spots, and the water deep up to Mutton Island; often anchored under the lee of Arran Islands, and knows them to break the swell into the bay; knows vessels often come of themselves to Mutton Island without a pilot; the bay is perfectly safe, but ships may lose their way unless they have a pilot.

There are about 600 fishermen in Claddagh; does not know that Claddagh is the best place for them; they have often to go out 30 miles to the fishing ground, and are often not able to find shelter for weeks; heard of Awleen as a good place for an asylum harbour; often talked over with the fishermen about it; there is a very bad entrance to the present pier of Spiddle, being too shallow; can't tell if it filled up much since built; it is frequented by turf-boats, but not fishing-boats; high water is required to get into it; Awleen under all circumstances would be the best place for an asylum barbour; if a dock were made in it, it would be approachable at all times, but it would not be enough to throw out fishing piers; the piers at Claddagh are good, but the entrance to them is shallow; did not notice them to fill with more than six or eight inches of mud, since they were built; there was no objection to Claddagh, but that it is so far from the fishing ground; they have no accommodation for the disposal of fish at present, except by carts, but if the railroad were to come it would be of great advantage; Errisseer on the south island of Arran, would be an excellent place to make a harbour of refuge for hookers, and even for shipping; it would be a great matter to construct a breakwater, from Killeman Bay, across the bar to Kilronan point.

Knows the light at Mutton Island, and can see it in clear weather from Blackhead, or about ten miles off; the fishermen complain they cannot see it far enough; thinks it should be raised higher; north of Galway, the mists are high, and do not descend near the surface; the Arran light can be seen up to Blackhead; thinks a light would be wanting at Kilcolgan point; the present light at Arran says "keep off," but thinks "a come to" light should be erected at the west end of the island.

Is acquainted with the north and south sounds of Arran Islands, and there is nothing, but the danger of striking upon Finnis Rock, to prevent ships in high wind making either entrance; it shows at low water of spring tides and is very dangerous; a buoy would be serviceable; knows one or two wrecks to have taken place there.

A perch would also be wanting for Englishman's Rock at the entrance of Greatman's Bay, and another for Mintel Rock near the north sound; knows a Government vessel about 25 or 30 years ago to have struck upon it.

The rock is within a quarter of a mile of the shore, but vessels often wish to keep to shore to make the harbour; another perch would be wanting at Carragoarogue, and a light is very much required at Nimmo's Pier; an application was made for it to the Harbour Commissioners, but nothing was done.

Has known several boats wrecked for want of a light there.

Captain **WHYTE** said he knew five or six boats to get into great danger at the rear of that Pier for want of a light there.

Thinks it very much required to have Nimmo's Pier connected by a causeway to the Claddagh.

Mr. Barry, one of the Inspectors of Fisheries, was told of it, and he said it was much wanted, but he did not say the Board would do it.

The **COMMISSIONER** here made inquiries as to the powers of the Harbour Commissioners, with regard to the appointment of pilots.

Mr. **STEPHENS** explained, that in getting the Harbour Act, the office of pilot was, through the interference of the present Lord Dunsaudle, preserved to Mr. P. Halloran, during good behaviour; but by a clause in the Municipal Act, in case the pilot should forfeit his right, the Board would then be at liberty to appoint more than one pilot.

The **HIGH SHERIFF**.—We would want two pilots at least, the fishermen at Arran sometimes pilot in vessels.

Mr. **STEPHENS**.—By all means, a pier should be constructed at Mutton Island to deep water. The light there should also be raised in height, or increased in size, and a light erected at Nimmo's pier to serve boats, with the removal of the bar at the entrance of the dock, paramount to all.

Captain **JAMES PRICE** examined.—Is in the habit of trading to the port of Galway nearly 15 years, and from what he knows of the bay and port, that running in, in a gale of wind, the present light at Arran is no good, but ought to be placed on Brannagh Island. In hazy weather especially, the light is too high, and is no guide whatever—according to the wind ships make either sound. If the light was on Brannagh Island, they could run in without danger, in the heaviest gale—thinks a floating light at Blackrock is much wanted to lead up strangers.

COMMISSIONER.—But is not that near Mutton Island?

Captain **PRICE** replied that it was within three miles of it, and he did not think it would interfere with the other. In hazy weather he had often seen the rocks, before he could the light on Arran.

Mr. **MACLACHLAN** handed in a letter from Mr. Blake of Furbo', in which he stated that about 20 years ago, a boat harbour was made available there by the late Alexander Nimmo, but in a storm in 1831, it was greatly damaged. He made application to the Board of Works for its repair, and Mr. Clements, county surveyor, was appointed to inspect it, but nothing since was done. He believed the estimate Mr. Clements made was about 150*l*.

Mr. **BLAKENEY** said, as he was not present when the railway was spoken of, he wished to learn from the Commissioner the line it should take in coming into the town. Lord Wallscourt said before that it would be necessary to turn the course of the water of Lough Corrib, with a view hereafter of converting Lough Athalia into a floating dock, and if that were the case, he (Mr. Blakeney) wished to know if the railway alluded to, which required to have a bridge built across Lough-Athalia, would not prevent such an improvement? That was the time to know it, while another line was intended to be run in a different direction.

The **COMMISSIONER** said that, without having the whole of the plans before him, he could not venture to give any opinion as to the respective merits of railways—but of this they might be assured, that if any line of railway would prevent the prospective improvement of the port, the Admiralty would not permit it to be carried out.

The **REV. T. R. RUSH, P. P.**, said, that he was one of a committee formed some time ago (when Mr. Barry, one of the Inspectors of Fisheries, visited Galway) for the purpose of providing some

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means to benefit the condition of the Claddagh fishermen, and that having entered into communication with some of the landed proprietors along the coast, he had great pleasure in mentioning that should Awleen be pitched upon for an Asylum Harbour, Mr. Comyns, the landlord, a benevolent and excellent gentleman, would give 100 acres of ground on the most reasonable terms, for the accommodation of such of the Claddagh fishermen as might be willing to reside there.

He submitted a list of the wrecks and losses to fishing boats, which took place on various occasions of late, for the want of a harbour of refuge.

No. 89.

Captain EVANS, R.N., *on Galway Bay*—1835.

No. 89.
Evans's Report on Galway Bay.

Galway is a tide harbour, the quays on both sides of the river being dry at low water. The rise and fall in ordinary spring tides is 14 feet.

Galway Roads is the only place where a vessel can lie afloat at low water. It lies to the south-east of Mutton Island, and has from three to six fathoms good holding ground.

At present this roadstead is exposed to the south-west gales, and requires a breakwater to be run out from the south end of Mutton Island to protect it. The breakwater would not extend more than two cables' length to the southward of Mutton Island, to embrace a good anchorage with four fathoms at low water spring tides.

Mutton Island being steep to, an excellent quay might be constructed at a moderate expense, along its southern beach, connecting the inner part of the breakwater with Slate-quay, now forming the larboard entrance into the river.

Along the quays ships would always be afloat, and be well protected, having their heads to the south-west, the best possible direction.

A ridge of rocks extends from Mutton Island to the mainland, over which an excellent causeway might be constructed. The expense of the work would be amply repaid by the value of the land for building store-houses.

A tramroad along the causeway would facilitate the removal of cargoes; and for all commercial purposes, be equal to having the ships at the town.

A very good dock is now constructing at Galway, which at high water will admit vessels drawing 14 feet. This is intended to communicate with a lake above the town, and thus open the resources of the country.

This dock will be useful for steam vessels until the breakwater is made, as they can lie afloat in it.

Westerly gales alone could prevent a vessel beating out of Galway Bay; and sheltered as the bay is by the Arran Isles, if a ship could not beat out of it, she would make but little progress outside.

A vessel beating out of Galway Bay has the same advantage as if she were beating out of the English Channel; that is, by keeping in the parallel of latitude of the bay, she would have several harbours under her lee in case of necessity.

Galway, in my opinion, is too far north for a packet station, independent of its being situated at the bottom of a bay, which must naturally retard both the arrival and departure of the packets; but if a breakwater was constructed, it possesses advantages that might make it a commercial town of importance.

No. 90.

List of Wrecks near Slyne Head, on the Coast of Galway, during the last 20 Years.

No. 90.
Wrecks in Connemara

	Name of Ship.	Cargo.	Where from.	Crew.	Vessel and Cargo.	Where Wrecked.
1825	Emilia	Timber	Baltic	Saved	Lost	Duck Island, ½ m. E. of Slyne Head
1826	Buckingham	Timber	Baltic	Lost	Lost	Murray Point, S.E. of Slyne Head
1827	Unicorn	Grain	Aberdeen	Saved	Lost	In breakers, E. of Slyne Head
1828	Sam. Whitehead	Timber	London	Lost	Lost	Gurteen Point, S.E. of Slyne Head
1831	Cathleen	Ballast	Plymouth	Saved	Lost	Slyne Head rocks
1832	Wm. Booth	Timber	Belfast	Saved	Lost	Erislanen, Mannin Bay
1833	Dash	Butter	Weymouth	Lost	Lost	Claggan
1835	Albion	Wheat	Carlisle	Lost	Lost	On Carrigh-a-roan
1836	Diana	Oats	Greenock	Saved	Lost	Kingston.
	The Slyne Head Lights were first exhibited in 1836.					
1837	Killigrew	Wine	Cadiz	Lost	Lost	Mannin Bay
1840	Chick Castle	Timber	St. John's, N.B.	Saved	Saved	Near Roundstone, bound to Liverpool
,,	St. John's	Timber	St. John's, N.B.	Lost	Lost	Eshel, near Carrigh-a-roan
,,	Martha Harrison	Oil	Liverpool	Saved	Saved	Stranded on a reef near Slyne Head
1841	Neptune	Timber	Bjorneburg	Lost	Lost	On Carrigh-a-roan
1842	Catherine	Ballast	Cork	Saved	Saved	Near Omey
1843	Nelson Wood	Sugar, &c.	Maryport	8 drowned	Lost	Mace Island, S.E. of Slyne Head
1844	Lady Grace	Iron, pottery, &c.	Kilrush	Saved	Lost	On a rock S. of Carrigh-a-roan.

Clifden, Connemara, 2nd October, 1845.

MARTIN R. HART.

APPENDIX B.

NEWPORT AND WESTPORT.

No. 90 *a.*

Evans, on Newport and Westport Bays.

No. 90 *a.*

Captain EVANS, R.N., *on Newport and Westport Bays*, 1835.

Newport and Westport Bays are full of overfalls, with very irregular soundings; and although I did not find less than five fathom outside the islands, yet they require to be very carefully surveyed before generally made use of.

Innislyre Harbour is formed by an island of that name, and is capable of admitting vessels drawing 14 feet of water at all times of tide. It is a very safe and good harbour. The entrance, which is narrow but deep, lies between the lighthouse on Ennis Gort and the bar; in it I found eight fathoms until I passed the lighthouse.

About a mile west of the lighthouse several patches of from four to five fathoms, with very irregular soundings, will be found; but, on approaching the lighthouse entrance, the water deepens to 9 and 10 fathoms.

The channel into Innisgould would require to be well surveyed; but when once in, very good and safe anchorage will be found.

No vessel, except in case of necessity, should attempt these harbours without a pilot, but particularly that of Innisgould, as the Laarbaan Rocks, which lie about a mile out in the bay, do not show, except by the sea breaking on them at low water, and are directly in the way of a vessel running for Innisgould.

To make Innisgould safe, there should be a lighthouse on the Laarbaan Rocks.

To render the harbours inside the islands of Newport Bay available for shipping, it will be necessary to survey the bay well; and owing to the irregularity of the soundings, great pains must be taken to ascertain the proper depth of water.

Additional lighthouses must be erected to point out the entrance to Innisgould. Pilots must be always ready at Clare Island to board vessels as soon as they get to the eastward of the island. Wharfs must be erected in the harbours among the islands, and these must be connected with the mainland.

These necessary works would require a considerable outlay, but they might be easily and readily performed, and render the harbours inside the islands of Newport Bay a desirable place for shipping. Newport Bay is, in my opinion, equally objectionable as a packet station as that of Galway.

SLIGO.

No. 91.

Evidence taken on the 24th Sept., 1845.

No. 91.

PORT OF SLIGO.

Examining Commissioner—Captain WASHINGTON, R.N., F.R.S.

Present:—The MAYOR of SLIGO, Alderman O'CONNOR, Captain VERNON, Mr. WYNNE, Mr. ST. LEGER, Alderman FAUSSETT, Mr. VERDON, Mr. SCOTT, Mr. P. O'CONNOR, &c. &c.

Mr. DAVIDSON examined.—Is secretary to the Commissioners of the town and harbour of Sligo. The Commissioners act for the town as well as for the harbour; they are elected by the 20*l.* householders, and hold office for life. The local act is the 43rd of *George the Third*, cap. 60. The income for 1843 was 628*l.* Salaries and incidental expenses amount to 300*l.* a year. Salaries alone 186*l.*, or 30 per cent. of the whole income. The accounts are not published.

Mr. MOSTYN, Ballast Master and deputy Harbour Master, examined.—There are several ship-owners town and harbour commissioners, but no sailors. The executive part for the improvement of the harbour has been entrusted by the general body to a committee, and this plan has been found to work well; is acquainted with the harbour for the last 19 years; it would be greatly improved if there were a greater depth of water on the Flats; this could be only obtained by removing those obstructions. Is not aware of ballast or shingle being thrown into the channel by ship-masters. Never knew but one instance in which it was done, and then the party was fined. Does not know of any encroachments having been made upon the shore, except at Lynn's dock; and that is considered private property. Cochrane's Quay is beyond high water mark; it was built in 1829. He had not the consent of the Commissioners, or of the Admiralty, for erecting it.

Captain VERNON.—The channel and shore are extensive, and it has always been considered here, that the landlords of the property adjoining the shore had a right to the shore also.

COMMISSIONER.—No private individual has a right to place any projection below high water mark without the sanction of the Admiralty; by the Act 43 Geo. III., cap. 159, he is liable to a penalty of 200*l.* for so doing.

Alderman O'CONNOR.—Have the proprietors of these properties near the shore the power to prevent the Commissioners from making on that shore what they may deem necessary improvements to the harbour?

COMMISSIONER.—Certainly not:—but when any such point should arise, a reference to the Admiralty will settle it.

Mr. MOSTYN.—I do not know of any bad effects having followed the erection of any projection. The old bridge does not prevent the flow of the tide above it; but the tide is checked by Mr. Martin's weir. Cannot say that the weir was erected by virtue of the provisions of an Act of Parliament. Does not think the weir prejudicial to the harbour, as the river is not navigable up to that; recollects having seen 75 ships in the port of Sligo; that was in 1826; there was very bad accommodation for them then, and they were six deep. The quays have been greatly lengthened since that period. The Ballast Bank Quay is 2248 feet long, and it was erected by the Commissioners at an expense of 2704*l.* The funds were raised by the dues of the harbour. The harbour is at present 750*l.* in debt, and the new works will increase the debt to 2000*l.*; part of that will be expended upon removing the Blennick Point; a portion of the money required for that work was subscribed by private individuals; 1500*l.* was produced in that way, the Commissioners having agreed to give an equal sum. The whole liability of the harbour will soon amount to 2500*l.*, including the cost of the private Bill for levying an import and export duty. Considers that the removal of the Blennick will be of the greatest service to the port; it will deepen that part of the channel 4 feet under low water mark, leaving 17 feet of water across the Blennick at spring tides. The Pool affords safe and secure anchorage. There are buoys

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to point out the course of the channel from the Point to the Quays; there are at present two steam-tugs belonging to the harbour. The only complaint I have heard made lately was about the front of the Quays, and directions have been given to have them cleaned. Remembers to have seen vessels blown away, owing to their having been badly moored; the captains are obliged to moor the vessels themselves; the harbour-master has only to point out their berths to them. Does not remember any vessel having been blown away since the storm in January, 1839. With regard to the mooring of vessels, it is right to say, that half-a-crown is charged at the old quays, that is, at the Custom House Quay and Mr. Cochrane's Quay; they are both claimed as private property. The proprietors had no permission from the Commissioners to erect them; Cochrane's Quay was projected without any authority whatever: it is a great obstruction to trade; if a vessel only throws a rope on it, 2*s.* 6*d.* is charged; the angles in the channel, particularly Lynn's place, causes a deposit of mud.

Mr. PETER O'CONNOR.—A part of the old quay was built by private subscription many years ago. The opinion of the late Mr. Saurin was that Lynn's place belonged to the crown. The tide formerly flowed over where Mr. Lynn's house is now built.

The MAYOR.—The impression formerly was that the landlords had a right to the shore down to low-water mark.

Alderman O'CONNOR.—Lord Palmerston remarked a few days ago that it would be a great advantage to throw a drawbridge from the old quay to the Ballast Bank across Lynn's dock.

Mr. MOSTYN.—Vessels are frequently obliged to leave the old quay, and take in a portion of their cargo at the Ballast Bank. There are no complaints as to the want of lights about the harbour, in fact no harbour in Ireland could be better lighted; but there have been complaints about the sand-banks.

The *Andrew Nugent* was lost upon the middle bank.

If a vessel should happen to draw more than 13 feet, it cannot at present come up our quays.

There have been complaints as to want of depth of water on the middle, upper, and lower banks. All large vessels have to discharge a part of their cargoes at the Pool.

The MAYOR.—Are not the merchants put to a great deal of inconvenience and trouble, by having to send goods down in lighters, or on carts to the Pool? And this inconvenience is caused by the shoals in the river?

Mr. MOSTYN.—They are; and if any losses are sustained, the Insurance Companies are not liable for them.

If the shoals were removed large vessels could come up.

The Commissioners made the dock, called Lynn's Dock. It is so called because Mr. Lynn built a house at the edge of it.

There are cranes and mooring-posts at the quays, and a new crane would be of use at the Ballast Bank. It would be very desirable to make a dock at the Ballast Bank if there were funds to do so. When vessels are repaired they have to beach them; a dock would be most necessary.

We have no place to build or repair vessels at present; nor have we got machines to deepen the harbour, because we have no funds.

I can think of no improvement equal to the removal of the Flats. The harbour will not be in the state it should be until they are removed.

We have a large steamer trading to the port; and she finds great difficulty in getting up to the quay in consequence of the narrowness of the channel, and the Flats. I recollect having seen the *Glasgow* lying on the banks; I have also seen the *Rover* detained for some days.

The Longford and Mullingar Railway, and the Sligo and Enniskillen, are coming to the port.

There are sufficient posts for mooring vessels at Oyster Island.

About three years ago two vessels would have been lost, were it not for the mooring-posts at Oyster Island.

There has been but one vessel lost in the harbour for the last twenty years, and that was the *Culloden*. Once saw 75 vessels in the port together. The average is from 20 to 25. Can produce returns of the arrivals and sailings.

Mr. WYNNE, Collector of Customs—Stated that the number of vessels coming from foreign ports in 1844 amounted to 32, tonnage 6327. The number of coasters was 421; tonnage inwards, 37,451; outwards, 49,337. The custom duties for the year ending 5th January, 1842, amounted to 31,994*l.* 6*s.* 10*d.*; for the year 1843, 29,969*l.* 5*s.* 1*d.*; for the year 1844, 31,531*l.* 8*s.* 8*d.* Thus the port of Sligo pays on an average 30,000*l.* a year customs; although the duties have been considerably reduced, particularly on sugar, there has been no falling off in the revenue, which shows that there has been a considerable increase of the imports for the last year.

Mr. MOSTYN.—Often recollects to have seen vessels coming into port with the loss of spars and masts; they got them repaired here: they could not have them repaired in any port between Galway and Derry, but Sligo.

The Flats are a very great obstruction to large vessels in their passage up the river. An absolute necessity exists for having them removed, to make this a good harbour.

JOHN M'GOWAN, Pilot, examined.—Has been a river pilot for a great many years; recollects many changes having been made; they were all improvements. The Flats are a great impediment; until they are removed large vessels cannot be brought up to the quays.

The anchorage is good in the bay. I knew of one vessel having gone ashore at Raghly Point; I was in her at the time; the wind suddenly shifted from south-east to north-west, but it was not the fault of the holding ground; it was a sudden change in the wind; the bay is considered safe.

There are twelve pilots appointed by the Sligo Harbour Commissioners; they serve an apprenticeship, and are afterwards examined by the master pilot and the harbour-master; the pilots are paid by the foot, according to the draught of the vessels. One or two posts are required at present at the north side of the river; two more should be placed at Roddy Bruen's, at the island; there were rings there, but they were forced away by a vessel. The steamer complains that two or three perches are wanted between the second and third perch now in being, on the starboard side, coming up; by placing lights upon them, which would be found by the vessels, there would be no difficulty in reaching the quay at night; those lights could be easily placed upon them. Posts would do for the perches, without any stone work; the steamer cannot turn in the channel, in consequence of her great length; but if the Flats were removed, she could. The bar of the bay is above the Black Rock.

There are between 9 and 10 feet of water at the bar, at low water mark; never touched it for want of water. There are leading lights to guide them into the port; there is a buoy at the Wheaten Rock.

Captain **VERNON**.—A perch would be far preferable were it not that great difficulty would be experienced in erecting it.

PILOT.—The buoy at the Wheaten Rock is often washed away; does not know that the Ballast Office of Dublin erect perches outside of the harbour. Has frequently brought vessels both up and down the river. When there is a strong fresh in the river, it is found very difficult to pass Lynn's Dock from the old quay to the Ballast Bank. Is of opinion that it should be kept as a floating dock; the bottom is all mud, so that vessels could receive no damage.

Was often, in piloting vessels, going aground on the Flats, and always experienced the greatest trouble to get them under way again.

The Flats are the only obstacles in the way from the island to the quay, and if they were removed there would be no difficulty in getting up.

A vessel in distress, or wanting repairs, could run into Black Sod, Broadhaven, Killybegs, or Loogh Swilly, but they could get nothing done in any of these ports, in the way of repairs. Sligo is the only port on the whole coast where a damaged vessel can be repaired, and therefore is the only place that deserves the name of a harbour of refuge.

The harbour lights are quite sufficient. The first thing seen outside in hazy weather is the land; it is seen before the lighthouse. In running for the Black Rock you will see the outline of the land before the rock. Thinks that it would be better to have the lighthouse black or striped, than white. Is of opinion that solid walls would be preferable to perches; is regularly in the habit of bringing up vessels to the quays at night; the traffic has greatly increased lately; floating docks would be of considerable advantage to the harbour; the shipmasters are most anxious for them; often heard them say so. If they had only funds to dredge the river, so as to enable vessels to lie in deep water, or to make docks, would prefer the dredging as more calculated to benefit the harbour; both would be required, but the dredging was of more importance of the two. There are seven pilots outside the river for the bay; they are the Raghly pilots, and are not included in the twelve inside the Oyster Island. Does not recollect any serious accident having occurred to any vessels in the harbour for the last six years.

Mr. **SCOTT**.—The pilot-boats are too small at present; they are mere skiffs, and are not able to stand a sea.

PILOT.—It would be necessary to have sailing-boats for the pilots; hookers could be got which would live in a heavy gale of wind; charts of the coast could not be had in Sligo, though it would be desirable to have them.

Mr. **ST. LEGER** examined.—Is county surveyor of Sligo, and has been so for the last nine years; has surveyed the harbour, and turned his attention very much to it; knows the middle, upper, and lower banks; a great change has taken place in them since 1822, when Mr. Nimmo's survey was made. The middle bank has increased more than one-half, and it is now of quite a different shape; the same may be said of the Seal bank; they have even changed since I made my survey. This shows the necessity of directing the tidal course; I conceive that Mr. Martin's weir prevents the tide getting up as far as it otherwise would; the tide comes within two feet of the top of the weir, but it could not go higher than the distillery, as there is a second weir there; the weirs also prevent the fresh water from coming down with concentrated force, and are consequently very prejudicial to the channel; the strongest body of water is required to keep the channel clear; is acquainted with the flats; the upper and middle banks are composed of sand; about one-third of the Blennick has been removed; the south channel has been narrowed up since the operations have commenced at the Blennick, and now the pilots go by the north channel.

Mr. **PETER O'CONNOR**.—If the weir at the distillery were removed, would it not be of service to the channel, by causing a greater body of water to flow into it?

Mr. **ST. LEGER**.—The removal of that weir would lower the level of the lake too much, but a lock could be placed there. If the weirs were removed the tide would not flow into the lake; there is a rise at the distillery that would prevent it.

Captain **VERNON**.—Does not the same quantity of water come down at present, as would flow if the weirs were removed?

Mr. **ST. LEGER**.—Yes; but it would come with greater rapidity, and be of infinitely more service to the channel if the weirs were removed.

I think the proper width of the channel should be 450 feet; that is what it is at the Oyster Island. From Lady Sarah's bathing-place up to the quays it should be reduced, as there is no back water in that part of the river to keep a proper scour, and you must depend upon what you get from Cartron marsh and the river. About 300 feet would be the proper width at this point, and I propose to have two dykes made from Cartron Point. The Pool Caum bank is a great obstruction at the ballast quay, but it is in progress of removal by contract; it is rock; it will be removed to afford 12 feet of water; there is another ledge of rock at the custom-house, which should be taken away, and from that up to the old bridge is one bed of rocks. Cochrane's Quay is an obstruction, and ought to be purchased, and a continued line of quay made. I think it would be desirable to have a floating-dock. When the Blennick is removed it will have an effect upon the sandbanks; if the Commissioners had funds at their disposal it would be even better to deepen the harbour than to make docks. Has heard that the anchorage at the Pool is getting narrow; the consequence of this is because the tide washes the sand off a neighbouring bank, but this will not be the case when the Blennick is removed. I am of opinion that it will be necessary to change the course of the Rathbraghan river. The Sligo and Enniskillen Railway will take up a part of the north shore; it is intended to run it along the shore, and as near as possible to the water, filling up the Cartron marsh, which would be very injurious, as it would shut up a reservoir much required.

Mr. **VERDON**.—If the railway were erected upon piles with a swing bridge in the middle, would not the flow of the water be preserved into the Cartron Marsh, and would not the railway in that case be of no injury to the harbour?

Mr. **ST. LEGER**.—In that way the flow of water would be unimpeded, and no harm would ensue from the railway. There is another railway from Longford, which will run by Rathedmond to Mr. Kernaghen's houses; that railway will be of benefit to the port.

APPENDIX B.

SLIGO.

No. 91.
Evidence taken on the 24th Sept., 1845.

I cannot say that the company will give money to improve the port, but it is frequently done when mutual benefit is derived from it.

There are no less than five different railways purporting to come to Sligo.

There is the Shannon Junction Railway, which will make Sligo a port of the Shannon; it is at present the export town for Leitrim, Roscommon, Mayo, a part of Galway, Cavan, Fermanagh, and Longford. I have always found that deepening and widening a port increases the harbour dues. In Glasgow, in the year 1771, the harbour dues only amounted to 800*l.* a-year; they are now upwards of 50,000*l.*, which is chiefly owing to the great improvements, for otherwise the vessels could not have got up to the port.

The works are executed at present by contract. I think a contractor will get through work quicker than any public body would if they took it into their own hands.

I think nothing could be done with Cummeen Strand; nor would it be advisable, as it would narrow the channel and draw off the back water. I had a tide staff while making the survey; and I think registered tide observations would be very useful, and it could be done at a small expense: it could be erected at the sluice at the ballast bank.

The difference between the time of tide at the Blennick and the quays I believe to be about half an hour.

I think a Government survey of the bay should be made. Any man who knew how to steer could bring a vessel in safely with an Admiralty chart.

I know where the houses of the pilots are. The place is about three miles distant from town. A railway could be made with great facility to it, as it is nearly a dead level. If there were a proper quay built there vessels might lie at it, but I fear the current is too strong; and I would say that the town of Sligo does not want a quay at Ross's Point.

Mr. VERDON.—In consequence of an observation which fell from the ballast-master, I wish to ask Mr. St. Leger if he thinks the Sligo and Enniskillen Railway likely to injure the trade of this town?

Mr. ST. LEGER.—I do not think it can injure it; on the contrary, I am convinced it will benefit the trade. The only thing to fear is injury to the harbour, but that can be guarded against.

No. 92.

No. 92.
Nimmo, on improving the Port and Harbour.

Report of ALEXANDER NIMMO, *Civil Engineer, on the present state and means of improving the Port and Harbour of Sligo.*

Sligo, March 25, 1822.

The town of Sligo is situate at the upper end of that large bay of the Atlantic, which intervenes between the shores of Ulster and Connaught.

The northern side of this inlet has some good harbours; but, being situated in the uncultivated part of Donegal and although valuable for the fisheries, of little consequence in the way of trade or commerce, they afford especially Rutland and Killybegs, useful stopping places for vessels bound to Sligo, and detained by contrary winds. The same remark applies to Broadhaven in the Mayo side.

Within these the coast affords only shallow bar harbours, which, with the exception of Donegal, are only fit for the reception of small vessels.

Sligo is the best port in all this district, and being situated in a fertile and improving country, and accessible on all sides by excellent roads, has become a place of considerable trade, and while the harbour is preserved must always remain the chief market for the north-west of Ireland.

The population of Sligo is about 13,000 [in 1822.]* In the town and neighbourhood are, 1 distillery, 5 salt-works, 4 breweries, 5 flour mills, 8 or 9 bleach fields. From 3 to 4000 firkins of butter are sold in the market per week during the season. Thirty sail of vessels loaded with grain have left the quays in one tide. Twelve sail of square and sloop-rigged vessels belong to the port; five of them trade direct to foreign countries.

The shipping interest is much obstructed by the defective state of the harbour; the extent of wharf is small in proportion to the trade, the only good portion is that lately built for the use of the custom house, and that is all dry, at low water at high water: neaps there is only 8 feet, and at ordinary springs 12 feet water along the front of it. Below the quay the Channel is shallow and winding for 2 miles to what is called the Pool, which though narrow, permits vessels of any draught that frequent this port to lay afloat at low water. Beyond that lies a dangerous strong shoal called the Blennick, whence round the Oyster Island there is a deep channel to the mouth of the harbour, but outside of that is a bar with only ten feet at low water.

From the shallowness of the harbour channel few vessels frequent Sligo larger than brigs of ten feet draft, 150 to 200 tons; these are frequently long delayed in the Pool ere a favourable tide and wind occur to take them to the quay.

The intricate nature of the navigation will more plainly appear, from the following particular report and sailing direction, which I have drawn up from a careful survey.

Note.—The miles mentioned in the following report, are Irish miles, the bearings are by the Compass in 1822.

The soundings are reduced to the level of low water of a spring tide of 13 feet rise.

SLIGO BAY.

The Bay of Sligo is situated between the point of Knocklave, improperly named Gessigo on the charts, on the north, and the point of Aughris on the south, both in the county of Sligo, the exterior bay is nearly four Irish miles square; but there are three large arms, each extending about three miles farther inland, but which are barred across the mouth, and mostly dry at low water. There are the harbours of Lisadell or Drumcliff, Sligo, and Ballisodare, the best and safest of which is that of Sligo.

THE LEDGE.

Across the mouth of Sligo Bay, from Aughris to Raghly and Knocklave, runs a reef of rock below water, called the Ledge, on which there is a heavy breaking sea in westerly winds, but it forms no

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* Now 14,318 inhabitants.

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obstruction to the navigation, as there are seven fathoms water across it; the depth outside is from 20 to 50 fathoms, but within little more than ten.

The north end of this ledge appears above water in the islets called Hawlbowline, and Little Island, in the peninsula of Raghly, and point of Knocklave; also in the seal rock, one mile S.W. of that point; and under water it forms the Wheaten Rock and Carriganean near Raghly Head.

The south end of the ledge appears in the middle of the strand, east of Aughris Point, forming the broad reef called Carrickfadda, or the long Rock.

This last rock is composed of sandstone; that of Aughris beyond it, is slate; and those within it, along the coast to Ballisadare, are limestone. As this is the regular position of that sandstone rock, viz., between the limestone which lies over it, and the slate or other primary rock which lies under it, as may be seen round the lower part of the mountain of Benbulben, we may in the supposed breaking up of this sandstone bed by the action of the western ocean, account, in a probable way, for the great mass of sand that has filled so much of these inlets, and occupied most of the eastern shores in the bays of Sligo and Donegal, and in particular, and more immediately to our purpose, we may perceive that the great mass of sand which covers so much of the interior of Sligo Harbour, being surrounded on all sides by the limestone dipping under it, is not an original stratum in that situation, but has flowed in from the bay by the action of the ocean and westerly winds.

AUGHRIS BAY.

Between Aughris and Carrickfadda, on the south side of the bay, lies a light, with deep water and clean ground, called Aughris Bay, or Pullagheeny, where vessels may stop in off shore winds, but it is dangerous when the wind comes round to the northward of west, from the heavy ground swell which then sets into it, and which, I fear, precludes it from being ever converted into a place of any safety for shipping.

BROWNS BAY.

On the north side is Browns Bay, between Raghly Head, and the Isle of Hawlbowlin, it is quite open to westerly winds, but having a bottom of clear firm sand, is used by vessels to stop in during easterly winds, for a favourable tide to go over the Sligo Bar. The seal rock in this bay is always above water.

RAGHLY.

Within this, is the small peninsula of Raghly, where there is a fishing village, in which pilots for Sligo Bar reside; between this and the Bar is a good roadstead, where a vessel may stop in three fathoms clean, firm sand, in making for which, observe the following dangers:—

WHEATEN ROCK.

S.W. of Raghly Head, one cable's length, is a ledge called the Wheaten Rock, only seen at low spring ebbs.

BIRD ROCK.

S. of the point is the Bird Rock or Carriganean, the north-west end of which, half a cable from the point, dries at half ebb, but a sunken reef runs off to the S.W., near a quarter of a mile. These rocks are improperly named in Mackenzie's Survey, and in the common charts; they are laid down in this survey in their true places.

In rounding Ragbly Head, you avoid the Wheaten Rock by keeping the tower of the Black Rock S.E. by S., on the high house of Forthill in Sligo, or to the eastward until you open the old castle of Ardtarmin, N.E., well out of the point of Roughly.

And to avoid the tail of Carriganone, keep the Sail Rock in view outside of Rougbly until you bring the same castle N.E. by N., you may then stand to the eastward and anchor in three fathoms, half a mile S.E of Raghly Point.

This anchorage would be of much greater importance to the Port of Sligo, were a small pier built on the shore of Roughly, near the point; this would not only protect the pilot and fishing boats, but small vessels might run in and take the ground within it, when the bar appears too much broken to go on to Oyster Island.

BLACK ROCK.

South by east from Raghly Point one mile, and half way to Coney Island, lies the Black Rock, on which a round tower of stone had been erected. This rock dries for a cable's length east and west of the tower of Bungar, and is in fact the extremity of a rocky *shoal*, which extends from hence to the north end of Coney Island, and on which, at spring ebbs, there is only three or four feet water. The channel into Sligo is close along the north edge of this shoal, and about a cable and a half wide, the bottom rising gradually from hence N.E. to the bar of Lisadell, shut in the Seal Rock at Raghly Head, and you are inside of the Black Rock, give the tower a birth of half a cable on the starboard hand, and having passed it W. or W. by N., within the Point of Aughris, to keep off the Bungar, but not farther than Tubberpatrick House; or W. half S. to keep off the north sand, on which there is two feet less water, until you are shutting in the small house of Oyster Island on the south point of the Rosses.

THE BAR.

When you have the two heads of Benbulben Mountain in one, you are on the shallowest of the bar, when there is ten feet water at low water of a thirteen feet spring tide, ordinary springs rise 12 feet, neaps 4 to 5, high water on full and change days half past five.

POOLDOY.

Having passed the bar, you are in Pooldoy, and may stop in three to three and a half fathoms loose sand.

OYSTER ISLAND ANCHORAGE.

With the Oyster Island house shut in as aforesaid, with Mr. King's house of Forthill, in Sligo, anywhere between the Oyster Island house and the Perch Rock, you may sail in through Pooldoy and the sound. Between the Rosses and Coney Island, and the Perch Rock, which is near the middle of this sound, take this Perch Rock on the starboard hand; it is steep, too, on that side: dries at half tide.

This water keeps in the mid-channel between Oyster Island and the main land of the Rosses, to near the end of the island, where you may moor with one warp to any of the posts on shore, and an anchor in the channel; there are rings also on the north side.

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THE BLENNICK.

The channel from hence turns to the southward round a stony shoal, called the Blennick, which runs off two or three cables length from the Rosses side; on this shoal there is a perch, as far as which it dries at low water, but the shallow continues some way beyond, and as there is a strong overfall tide across it, *vessels are frequently carried upon the shoal and bilged*; as this is one of the chief dangers of the Port of Sligo, it would be very desirable to have a channel cut across it, as low at least as low water springs, which would be sufficient to admit the passage of any vessel that now comes to the quays.

SEAL BANK.

The stream of flood across the Blennick being shot off to southward has excavated a gullet or false channel, which passes some way into the West Strand, between that and the pool or fair channel, is a long narrow spit of sand, called the Seal Bank.

THE POOL.

To get into the Pool, round the Blennick, in the best water, stand over mid-channel between the Island and the Perch, until you have the Pilot houses on the green point of Oyster Island; keep them so until you have Washington House well out of the Point of Ballyweelin, then keep that mark into the Pool. You may moor here with your anchors N. and S. Athwart the stream in 2 to 2½ fathoms; the depth continues for about half a mile.

SOUND OF MUYLE SRUENA MUYLE.

The opening on the west of Oyster Island, is called Sruena Muyle; but it is not to be attempted but in case of necessity; being narrow and rapid, the overfall of flood through it produces a vortex, which has scooped a deep hole or pit on the inside of the narrow, fourteen fathoms deep. A channel continues this way along the south side of Oyster Island, up to the Blunick; the western part appears to shift frequently among the loose sand.

CONEY ISLAND.

Coney Island lies across the mouth of the harbour of Sligo, and shelters it completely from the ocean; the channel between that and the main land of Kilaspeckbrone, admits boats only, and is covered by a low isle called Maguire's Island, accessible at low water from the south side; half a mile farther off is a dangerous sunken rock, called the Blind Rock, on which there is two fathoms at low water. This rock shows a breaker before bad weather, and must be avoided by vessels beating into Sligo or Balisadare. At the rock, Scarden Mill is open in the sound between Coney Island and Kilaspeckbrone. On each side of this sound are extensive banks of blowing sand; they appear to have afforded the great supply which has filled the interior of Sligo harbour; and unless precaution be taken to prevent the rapid destruction of the Bent Grass, it is much to be feared that, ere long, the Harbour of Sligo will be as completely lost as the inlets on the north west of Donegal.

WEST STRAND.

Within Coney Island, and up to Finisklin, 2½ miles in length, and one mile broad, is a flat beach of sand, with extensive beds of cockles and mussels This great body of sand appears to have been impelled by the joint action of the flood tide, and pravalent westerly winds, against the upper and northern part of the inlet, and having thereby confined the ebb stream against the opposite shore, the bank on that side has been swept clean of all finer matter, and its bed left no wider or deeper than the ebb stream could keep clear. It will be observed, by a look at the chart, that, besides the general channel of the river, there are two hollows in the sandy beach, by which the water falling off this great flat, joins the general stream; the first of these falls in a little below the House of Washington, opposite to where the present road comes to the shore, and the increased back-water gives there an additional depth of at least a fathom; indeed, where it is confined by the oyster bed, and the spit called the Seal Bank, there is a depth of four fathoms, gradually diminishing to two, as we approach the Blunick; the pool above mentioned has been evidently formed or preserved by this accession of back-water.

The second hollow falls in at the lower part of the pool, and its effect in deepening the channel is lost on account of the immediate neighbourhood of the Blunick, which is too hard to be acted upon by the current; it is, however, the chief means of preserving a deep channel round the Blunick.

There can be little doubt, therefore, if the back-water could be increased at a higher part of the channel, that the depth which we have now in the pool might be brought up nearer to the town; but it would be necessary for this purpose to depart from the line of the present channel, as the bottom there is too hard to be much altered by the action of the stream. On the other hand it is probable that the body of sand in the centre of the harbour continues to a very considerable depth, and a channel formed across it would not only be preserved by a powerful back-water, but in all likelihood, be considerably deepened thereby, while the navigation would be materially shortened and simplified.

I shall now return to the description of the present navigation.

LOWER FLAT.

In the present channel, when we pass the hollow or pile above mentioned, we find, opposite Washington House, an extensive shoal, called the Lower Flat; the depth here is not above two feet; the channel originally run along the north shore, but has shifted to two cable's length from it.

MIDDLE BANK.

The bank between these channels dries at low springs, and is called the Middle Bank; it forms the tails of the lower flats.

The south channel has five feet water along the bank, and the sailing which leads through the pool, viz., the Herring Gap, on the House of Bath Lodge, will now do through this south channel as far as the castle of Ballincar; the mill stream seems too insignificant to have formed this shoal.

THE HOLE.

Above this stream, the channel being confined by the slab opposite the old castle, has scooped a deep place called the Hole, where there is 7½ feet water. The early ebb comes across the Strand, and is deflected by the north bank; at this place the sailing mark is now Lady Sarah's bathing lodge. On the two gateway pillars near Auburn, the depth through this reach lessens to 4 and 3 feet; and at the height of the channel opposite the Perch to 2 feet.

Appendix B.

Sligo.

No. 92.

Nimmo, on improving the Port and Harbour.

The Reach.

The channel now turns to S. S. W. ½ W. for half a mile, called the reach, and opposite the lower end of Mount Shannon, called the Stond Alone Point, there is a hard stony shoal, which, with only six inches water, runs two-thirds across the channel, and leaves a depth of one and a half feet at the extremity; above this are the Middle Flats, a sandy shoal with only a foot water, but rounding the Perch at the tail of the north bank, we have an increase of half a foot.

The early ebb and latter flood set across this reach, so that vessels are apt to be carried ashore on either bank; the channel is narrow and indirect; the sailing mark is the Rath of Ballincar, on the point of Benbulbin Mountain, or Carraway's House of Lodge, open of the cross road near Larkhill.

Upper Flat.

Above Finisklin Point the channel turns off again for the town, but for some way the depth is very little, being not quite one foot at low water springs, this shoal is called the Upper Flat, and on trial with the bar, appears a loose sand to at least four feet deep, which may be easily drudged; it is probably caused in part by the deposit from Rathbraghan river, and it would be advisable, if it return after drudging, to have that stream turned to a lower part of the channel, or to the neighbourhood of the narrows and prolong Stand Alone Point to the Perch, to prevent the early ebb from setting athwart the reach.

To sail through this flat, keep the angle of the barrack just open in the point of Cartron, and then mid-channel through the narrows.

The Narrows.

The river between the Cartron and Finisklin contracts to a width of 150 yards at high water, this place is called the Narrows, and has three feet water, the bottom is strong and could only be deepened by the diving bell, as the strong current of ebb has removed all loose matter.

Pool Com.

Above this to the quays, through what is called Pool Com, the same or a greater depth continues, and as the bottom is mud, where the channel lowered at the Narrows, there would be little difficulty in preserving that depth up to the town, the freshes indeed would soon deepen the portion of the channel from the Narrows, keep the wall on the Salmon point of Finisklin opening out of the high bank wall of Dorran's Isle, until you pass the perch of Pool Com, or shut in the old castle of Ballincar or Cartron you must open out this castle again, to get past the spit of the Barrackhill, or keep the steeple on the saddle of the mountain S. ½ W.; to the upper perch there is 4½ feet water through Pool Com, to the Barrackhill point, where we have two feet less, and shoaling gradually to the old quay where at low springs tide there is only the fresh of the river.

An attempt has been made to straighten the reach of Pool Com, by cutting a channel behind the perch, so as to permit vessels in scant W. S. W. winds, to pass directly down over the flats; such a passage would certainly be useful in the present state of the river, and could be brought to the level of the Middle Flat at no great expense; yet as we could not obtain so great a depth as in the present course, I would rather recommend a prolongation of the quays to the perch of Pool Com, and embanking the land behind which, I think may be effected in the course of the improvements now to be suggested, and by which I expect vessels of 16 feet draft may be brought up to the quay.

I shall first suggest a few improvements suited to the present state of the navigation.

Warping Buoy.

From the bridge to the quay, the stream of the river first sweeps the north shore, and is there deflected over to the lower end of the quay, vessels casting off are therefore often carried on the strand of Rathedmond before they fetch way to sail down the channel, a warping buoy laid in the channel between the fever hospital and the point, would be useful in preventing this.

Channel Perches.

In the present state of the channel, a perch would be useful opposite the shoal of Stand Alone Point, also on the point opposite Bath Lodge and Ballincar Castle, and on the new seal bank, a buoy on the lower end of the middle bank and the end of the old seal bank.

Marks in the Bay.

Outside of the perch rock, which I understand is to be marked by a tower and statue, much heavier chains and larger buoys would be requisite to mark any dangers, a buoy on the north bend of Bungar, between Black Rock Tower and Coney Island, and on the west end of Carriganeen, appear the most useful; but by attending to the sailing marks here given, especially if a light could be obtained on the Black Rock which is a highly desirable object, the dangers of the bay might be readily avoided.

Having thus described the present state of the navigation into this port, I proceed to the consideration of those works, which appear most necessary for its ultimate improvement.

The first and most important measure in my opinoion, is the obtaining a more direct and deeper channel between the town and the pool, for in the present course, I conceive no valuable or permanent improvement can be made between Stand Alone and Ballincar.

The straight line across the strand, seems to offer no obstruction to the excavation of a new channel, as I have had this strand bored along the line which I should recommend, to the depth of ten feet, and find nothing but loose sand, I have little doubt but the same stratum continues to a much greater depth, and such a channel being once opened, and properly defended by banks of stones and clay, and the back-water directed through by wires and jetties, would certainly be speedily deepened. I propose to carry this channel from the bight at Finisklin, to the back channel behind the new seal bank, were we will have as deep water as is round the Blunick, to open it first 3,000 yards long, 60 yards wide, the banks 100 asunder, five feet deep to low water springs at the upper end, and at the level at low springs at the upper end, and at the level of low springs 300 yards from the lower end. The banks to be first lined out with strong gravel and clay, procured from the beaches or other useful excavations in the channel, or the cliffs on the shore when raised two feet to be backed with sand, excavated from the cut sufficiently far from the banks to preserve them from slipping, when the channel begins to scour, the the banks to be heightened and backed successively, so as to preserve three feet thick of lining over the sand on the side of the cut.

No. 92.

Nimmo, on improving the Port and Harbour.

ESTIMATE FOR THE CUT.

5 yards wide of Stones and Clay, at 1*s*.	5*s*.	
8 Cubic yards of Sand, at 3*d*.	2*s*.	
	7 per yard running.	
For 2,800 yards on North Side	£980	
„ 800 upper South Side	280	
		£1,260

Excavating the remaining channel, and transporting same by boats, or wharfing it behind the banks, 160,000 yards, at 4½ per 3,000.

It is probable that much of this sand will run away by the action of the stream, which I have not reckoned upon; this again the stuff excavated here, would go far to fill up the Strand at Rathedmond, it would fill half of it to high water level, and if transported by boat, the most convenient direction would be somewhere up the river, the diminution of that much back water would be little felt to produce a Pond for back water to work down the Cut, there must be a low dyke carried along the high part of the Strand, and across the Scarden, to direct the back water of the slab to the head of the Cut.

	£.	s.	d.
2 Miles long, 3 feet high, at 28*s*. per perch	896	0	0
240 perches of other low Wires and Jettys	336	0	0
Contingent expenses—Boats, Drudges, Superintendence, &c., 20 per cent	1,098	8	0
Total for the new Cut	£6,590	6	0

This excavation is merely such as to produce the same depth of water in the Cut, as we now have on the Flats of the reach; but there can be no doubt from the nature of the soil, and the additional velocity of the stream, but that this channel will deepen materially when the Cut is once effected; therefore the old channel through the reach may be abandoned, and a dyke run across it near Ballincar, so as to send the whole of the back-water through the Cut. This last back-water will of itself be sufficient to keep the Cut clear, and that in case the slab on the south side may be embanked above high water and reclaimed.

We now proceed to the improvement of the upper part of the channel.

ESTIMATE FOR THE UPPER CHANNEL.

The shoal called the Upper Flat may be lowered by dredging; two feet additional depth will give the same depth as in the narrows.

		£.	s.	d.
700 yards long, 50 wide, 2 feet deep, at 2*s*. per yard, for dredging 23,333 yards		£2,333	6	8
Clearing Pool Com, and up to the Quay, 600 yards long, 1½ foot deep, and 50 wide at do., would cost		1,500	0	0

But I conceive it would be preferable to wall up and embark the bight of Rathedmond.

		£.	s.	d.
1,050 feet front at £2	£2,100			
Rough walling at ends	400			
Filling obtained from the excavation formerly estimated	£2,500			
Forward		£4,733	6	8

The only remaining danger in the channel, is the shoal called the Blunick, round which it is to be observed, we have nearly 8 feet water; this shoal I find to be composed of large boulder stones, imbedded in strong gravel, they may be lifted by tackles where accessible, and to cut a channel across to the level of low water springs, would require an average excavation of about 18 inches.

	£.	s.	d.
300 yards loog, 5 yards wide, and 1½ yard deep, at 1*s*. 6½*d*. per cubic yard is	2,250	0	0
	£7,083	6	8
Contingencies as aforesaid on these works, 20 per cent.	1,416	13	4
	£8,500	0	0
Total for the Cut	6,590	8	0
	£15,090	8	0

To go a greater depth here or at the stony shoals, in the upper part of the Harbour, would require the use of the diving-bell.

ALEXANDER NIMMO.

Sligo, 25*th March*, 1822.

No. 93.

Mr. TELFORD'S *Report, Sligo Harbour.*

No. 93.

Telford, on improving the Harbour.

London, 22*nd Oct.*, 1823.

Although the Reports respecting Sligo Harbour reached me early in August, the plans did not reach London until after I had set out for Scotland, since my return I have attentively considered the sundry communications, and carefully compared therewith the excellent chart of Mr. Nimmo.

The subject is of magnitude and importance, and after the most careful consideration I have been able to give it, I am induced to state my opinion, that with any probable means to be obtained, it would be unadvisable in that extensive mass of loose sand to attempt the new channel and embanked reservoir.

Not being fully aware of all the localities, I may be mistaken in what I am about to suggest, but so far as I am at present enabled to judge, I would recommend the Harbour Trustees to adopt the following portions of Mr. Nimmo's design:—

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Telford, on Improving the Harbour.

1. Extend the Quays as far as Pool Corn Perch.
2. Turn the river Rathbraghan to a lower part of the channel, and prolong Stand Alone Point in a direction and to correspond with the channel, as it would be formed by the extension of the Quays.
3. Endeavour by jetties and otherwise to remove the angle opposite the bathing-house.
4. Deepen and clear the channel by all practical means from the pool upwards.

The above comprehends all that I dare venture to recommend, and if effectually accomplished, would certainly considerably improve the port of Sligo.

THOS. TELFORD.

No. 94.
Halpin, on the proposed improvement of the Harbour.

No. 94.

Report of GEO. HALPIN, *Esq., Civil Engineer, on the proposed Improvement of the Harbour of Sligo.*

SIR,

I have the honour to acknowledge the receipt of your letter of the 21st inst, stating that the Commissioners for the issue of money out of the consolidated fund had been applied to from the Commissioners for improving the town and harbour of Sligo for an advance of 6000*l.*, and it was thought necessary "that I should proceed to Sligo with the least possible delay, and examine into the projected improvements, and report my opinion thereon, and give the Board such information generally as I might think useful and necessary." I have also the honour to acknowledge your second letter of the same date referring to the former, and mentioning that you had requested Mr. Hume, one of the Sligo commissioners, to furnish me with plans and estimates, and such other documents as I might think useful and necessary on the present occasion, and to acquaint you for the information of the former commissioners, that in obedience to their desire I proceeded to Sligo, previous to which I waited upon Mr. Hume, and got from him the survey of the bay and harbour of Sligo, lately made by Mr. Nimmo, civil engineer, together with Mr. Nimmo's observations and report thereon, with the suggestions of the improvements and estimates of the expense of completing the improvements he has recommended, all of which I attentively read and examined, and then proceeded to examine the river, harbour and other matters connected therewith to which the same had reference, and consider that the survey and soundings have been most diligently and accurately made, and for the guidance of mariners and those concerned in the trade and prosperity of Sligo the same is deserving of being engraved and published.

But with regard to the improvements recommended for the harbour and laid down in the survey by an examination through an extensive line of strand, to form the proposed channel commencing at the seal bank and continuing up the river and terminating near the hight of Finisklin, I do not consider myself warranted in concurring in opinion that the proposed new channel would be of advantage to the trade of Sligo under the existing circumstances, namely, that the great line of strand through which it is proposed to pass, consisting of soft sand only, if excavated without having sound embankments on either side from its commencement to its termination, which would assist the operation of the tide and fresh water currents, the proposed channel would soon fill up by the mouldering away of its sandy banks, and the sand that would be carried down by the ebb tide, and fresh water currents would probably settle below the new seal bank, and thereby form a bar and prevent vessels of a much less tonnage than are now in the habit of trading up to the quays of Sligo, getting further up than below the new seal bank, but if there were sufficient funds to undertake and complete the proposed excavation and channel, and also to form sufficient embankments on either side, capable of resisting the operation of the tide and fresh water currents, then I would concur in opinion with Mr. Nimmo, that it would be advisable to commence and complete the proposed new channel to which the 6000*l.* applied for is totally inadequate; added thereto, I am of opinion if the embankment around the proposed reservoir was formed, and as laid down in the survey, it would resist the flow of the tide, cause the floating sand to accumulate, and, on the ebb, draw it into the old channel below new seal bank, and contribute more rapidly to destroy the navigation of the river leading from the bay up to Sligo, all of which circumstances I pointed out to the commissioners of the town and harbour of Sligo, and at the same time submitted that, previous to their commencing such an undertaking as that proposed, they should be fully satisfied that in every respect it would, without any doubt, be advantageous to the commerce of Sligo; and that the best authority to which the matter could be submitted was Mr. Telford, that was considered by Government the most efficient person to succeed Mr. Renny, lately deceased, and was now engineer under Government, and conducting many public works, particularly those connected with harbours.

The improvement recommended, commencing at quay of Sligo, and ending at Finisklin Point as laid down in the survey and particularly mentioned in Mr. Nimmo's report and estimate, in my opinion (in every shape) is deserving of adoption, it will naturally improve the harbour, and give employment to the poor, the estimate sum being 2500*l.*

I herewith send the survey of the bay and harbour of Sligo, together with the report, observations and estimate, made by Mr. Nimmo before mentioned, to be laid before the commissioners, which you will please to return to Mr. Hume as soon as convenient.

I have, &c.,
GEORGE HALPIN.

To John Galloway, Esq., &c. &c. &c.

No. 95.
Gibbons on the Harbour.

No. 95.

Report of BARRY D. GIBBONS, C.E., *on Sligo Harbour.*

SIR,

Kingstown, 7th May, 1844.

In obedience to the Board's order of 27th ult., I proceeded to Sligo, and made a very minute examination into the state of the harbour navigation, and having had benefit of fine weather and particularly low tides, I was enabled to do so with great satisfaction. Comparing the present state with what the excellent chart furnished by the late Mr. Nimmo exhibits, the course of the current appears to have undergone some changes, with rather a diminution of depth, though not to any serious extent, as well as I could compare by the soundings I took without having any fixed tidal gauge. After reading the reports of Mr. Nimmo, Mr. Telford, and Mr. Halpin, and giving to the subject the best consideration in my power, I am quite satisfied it would not be advisable to attempt the foundation of any new channel through the sand strand as proposed. In my opinion, all operations for the improvement of the

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navigation should be directed to the line which the current has naturally taken (except where diverted by removeable obstructions), namely, along the high land on the north shore, though this course has not the advantage of being as straight as that proposed. The depth of water is very uniform throughout, and is about 13 feet at N.W. springs, and 8 feet at neaps, except on the three flats, where it is 12 to 18 inches less, this leaves the depth at at a point at which a very moderate increase would be of vast importance; two additional feet would enable very large steamers, and the class of vessels in the trans-atlantic trade to come up every tide to the quays. It would be of great value to the town and adjacent country to have the benefit of steam navigation regularly maintained with the Clyde and England; it would be bringing the produce of the cheapest and most backward part of Ireland within the reach of the best markets in the world. To effect this increased depth, the only means within the reach of the funds there would be any hope of procuring, are by dredging the flats and channel course, and by the removal of the Blennick point; this point consists of loose boulder stones and coarse sand, standing about two feet six inches over low water spring tides, and in the direct course of the current immediately above Oyster Island. The first of the flood tide meeting this interruption is deflected against the loose sand bank on the south, which it wastes away and deposits where any retardation takes place, and hence is evidently the formation of the middle bank. I have no hesitation in saying that the mere removal of this obstruction would have a very beneficial effect, it would immediately give the tidal current a more direct course and expedite the time of high water up the river. This could be effected without a dredge by the lighters at present belonging to the Harbour Commissioners; and as far as half a foot to two feet six inches below low water springs may be done for 300*l.* to 350*l.* To produce the depth of water over the flats and in the channel generally, which I consider essential to the prosperity of the port, namely, 10 feet at neap tides high water; it is, in my opinion, indispensable that an efficient steam dredge should be employed. I have bored and examined the flats and bed of the channel and the banks, and they consists of a stratum of coarse sand, from two to three feet thick overlaying clay. I feel how discouraging it is to recommend what involves the prospect of a continuous outlay. But the object would be well worth the cost, and I am, moreover, very confident that if the dredging were judiciously conducted for a limited time, and the Blennick removed, the current would be brought into train, something like an uniform channel would be produced, and the dredge would be only occasionally required to remove obstructions that may from time to time arise. When about to commence operations it would be essential that the line to which the working should be confined be marked off as coloured on the chart; I have endeavoured to lay out this course in as easy levels as possible, without getting into the soft or high sand banks, or seriously increasing the depth of the stuff to be removed. While I strongly feel that the improvement of this harbour is peculiarly deserving of favourable consideration, yet I am bound to state that for a loan the Harbour Commissioners have but very scanty security to offer to the Board—

The dredging establishment would cost about . . .	£4,000
The private subscriptions will possibly amount to . .	1,500
Suppose a grant from the Board of equal amount . .	1,500
	£8,000
A loan would be required, to set up the establishment, of at least	£1,000
The gross revenue averages per annum	600
Upon this there are indispensable charges for interest, salaries, &c. &c.	400
Leaving only per annum about	£200

Which would be quite inadequate to the working of the dredge, with effect, leaving nothing for the interest or principal of the loan. I return all the documents.

And have, &c.,
B. D. GIBBONS.

Henry R. Paine, Esq.,
&c. &c.

No. 96.

No. 96.
St. Leger, on the proposed Improvements of the Harbour.

Report of NOBLETT R. ST. LEGER, C. E., *to the Commissioners of the Harbours of Sligo, in connection with the Surveys made for showing its present state, and the proposed Improvements required thereon.*

GENTLEMEN, *12th September,* 1844.

In accordance with the resolutions passed at your meetings, I have surveyed the upper, middle, and lower flats, and Blennick Rock, within the harbour; and also have made sections of the banks and rocks proposed to be removed for the purpose of straightening the present channel and giving a fairer course to the wharfage.

Commencing at the Cartron Point, two plans are presented for consideration for improving that portion of the upper reach composing the upper and middle flats—first, the old channel, as marked by the different perches and stakes between Cartron Point and the north side of the middle flat, to be deepened; and secondly, a new cut between the same points.

The old channel is circuitous and valuable in its soundings, with a bottom of hard sand and shingle, but which there would be no difficulty in removing; and to give a tide-way, 60 yards wide, with a depth of two feet of low water of a spring-tide of 13 feet rise, would require about 21,000 cubic yards of dredging is in length 1,444 yards.

This circuitous channel appears to have been formed by the strong shoal between Lady Sarah's bathing-house and the Stand or Stone Alone Point, called the Carrigeen, in length about 220 yards, which has evidently been the means of diverting the course of the up-coming stream from the east to the west side. This shoal is composed of loose rocks and shingle, running nearly half-way across the channel, apparently collected at some remote period for the purpose of making a ford, and mostly dry at low water, forming here a considerable obstruction to the navigation, and extremely dangerous and destructive to ships. The greater part if not the whole of this I would most strongly recommend to be immediately removed, no matter which plan may be ultimately followed.

The new channel, as marked on the map, starting from the Cartron Point and ending at Lady Sarah's bathing-house, with a curve of a radius of 1,360 yards, (which would appear to be the natural course of the tide if not obstructed by the Carrigeen) would pass through a bank of sand easily removed.

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St. Leger, on the proposed Improvements of the Harbour.

The proposed channel, 60 yards wide, (being the width of the river at low water at the starting point), would be 1,154 yards long, and would take about 54,000 cubic yards of excavation and dredging to give a depth of two feet at low water of spring-tides, of which 41,000 cubic yards might be done between tides. This course being 290 yards shorter, and being more direct than the present channel, would be far preferable; and when the Carrigeen shall be removed, I have no doubt that the run of the tide would not only keep this course open, but would probably be the means of widening it.

The banks forming the edge of the channel, and the soundings in this part of the river, have undergone very little change since the survey of the harbour by Mr. Nimmo in 1822; but the lower flat, middle bank, and southern channel have been materially altered since that period, so much so, that where there was then a depth of five feet at low water of spring-tides, there is now a bank two feet six inches high; and the middle bank, from being an oval shape, is now nearly the form of a crescent, but with the north side considerably extended towards the west, and the whole bank is more than twice the size it was.

The new Seal Bank has been entirely changed; and the channel between the Middle Bank and new Seal Bank, and that opposite the mill, much in width though not in depth.

These changes having taken place since 1822, I am led to suppose that they have been occasioned by the removal of the shoal on the east side of the Oyster Island, opposite the Blennick, and shows that the various sand-banks between the Oyster Island and the lower flat, are easily acted upon by any change which may be made at the entrance of the channel.

The Blennick Rock is evidently the most serious obstruction to the navigation of this whole river, as well from being in the direct course of the channel, as being the means of diverting the tide from the north to the south side; as the first of the flood coming with considerable rapidity and force, sweeps along with it a portion of the sand from the southern bank, which first obstructs its course, and is no doubt the principal cause of forming the Middle Bank.

The present south channel is much reduced in the width since 1822, and is now only 88 yards wide. And as this appears to be about the size of channel which the scour of the ebb-tide is able to keep open at all times, I have made it for the present the width of the proposed channel to be dredged through the middle bank, and to give a depth of two feet as calculated for the upper and middle flat, it would take 53,356 cubic yards of excavation and dredging.

I should not recommend any work to be done on this part of the channel for some time, as the removal of the Blennick, or even the channel which is proposed to be cut through it will, I have no doubt, make a considerable alteration in this bank.

The removal of the Blennick has been objected to by many, who state that it is the principal cause of the safe anchorage of the Pool, by forming a natural breakwater against the ground swell in westerly winds. This is a most erroneous opinion, as the Coney Island completely shuts in the mouth of the harbour, and breaks the force of the wind before it can enter the Pool.

The entire or even partial excavation of the Blennick would have a most desirable effect, by giving a free run to the direct course of the river, and preventing the many delays and inconveniences daily occurring in the stranding of vessels on it, and would therefore recommend the immediate removal of that portion of it marked on the plan, leaving a direct channel two feet below low water, 88 yards wide, and containing 11,146 cubic yards of excavation.

The remaining portion of the rock to the same depth, containing 8,682 cubic yards, might be taken away after the other improvements in the river have been completed.

The removal of the Carrigeen, together with the formation of the new channel in the upper reach, may be done for about £1,700. The Blennick Rock may be taken away for about £800; these works I would strongly recommend to be immediately proceeded with, as they appear to be within the probable limits of the funds at the disposal of the Harbour Committee.

The deepening of the lower flat and middle bank I would not recommend for the present, as I conceive that the operation of clearing away the Blennick will, in a great measure, be the means of removing the middle bank and altering the channel about it.

I have, &c.,
Noblett R. St. Leger.

No. 97.

Commissioners' Petition for the Improvement of the Town and Harbour.

No. 97.

To the Right Honourable the Lords of Her Majesty's Treasury.

The Petition of the Commissioners for the Improvement of the Town and Harbour of Sligo.

Humbly showeth,

That your Petitioners being incorporated by an Act of Parliament passed 43rd year of George 3rd for the improvement of the Town and Harbour of Sligo, have devoted their time and attention to the discharge of the duty imposed upon them, carrying into effect every measure which they conceived calculated to promote the prosperity and welfare of their town.

That with the limited revenue at their disposal, arising from a tonnage duty on the shipping of the port, and which does not exceed 600*l.* per annum, (from which is to be deducted, salary of secretary, harbour master, ballast master, quay constables, and expense of watch-lights, river buoys, mooring posts, &c.) They have of late years from time to time with the strictest economy effected considerable useful and valuable improvements in the harbour; that for some years past, the trade of this port has has so rapidly increased that the quayage was quite insufficient to accommodate the shipping. Your Petitioners therefore deemed it their duty to undertake the embankments of a strand adjoining the Custom House Quay, and have from their own means alone erected an extensive quay, about 2,225 feet long, faced with hammered stone.

That the erection of this quay, your Petitioners humbly submit, merits the consideration of Government, that it has exhausted their harbour funds, but it has rendered a most important service and accommodation to the mercantile and shipping trade, it affords three feet deeper water than at the upper quays, and enables vessels to take in their full cargoes, where formerly all drawing above nine feet water were obliged to lighten a portion of their cargoes to the Pool, a distance of four miles, at considerable delay, risk, expense and trouble.

That the only obstacle now in the in the way of large vessels of a heavy draught of water proceeding up and down the river at all tides, is caused by not having sufficient water over two parts of the channel, known by the upper and middle flats, which are composed of sand, and can be easily removed by

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dredging, this obstruction compels vessels of a heavy draught of water either to remain at the Pool for for spring tides, or lighten their cargoes at great expense to the quays; it often happens when spring tides set in the wind becomes unfavourable, and vessels are in consequence for weeks detained.

That in contemplation of removing the difficulties and obstructions complained of and so much against the mercantile shipping trade, your Petitioners a few years ago had a survey and map of the harbour made by the late Mr. Nimmo, civil engineer.

That this work, your Petitioners are unable to undertake in the present exhausted state of their funds, but finding that your Lordships are empowered to authorize grants of money in conjunction with sums to equal amount to be provided by bonâ fide subscriptions from other parties (which subscriptions your Petitioners have every prospect of procuring) to assist in carrying on public work, that will not only augment trade, but the revenue of the country, and give employment to the labouring classes, they beg leave with the most earnest and respectful solicitude to hope that your Lordships will deem so extensive and rising a Port as Sligo, entitled to a sufficient grant from the Government of the country, to assist in carrying forward so important a public work as that alluded to; your Petitioners beg leave to state, that the Port of Sligo has yielded a revenue to the Crown for the last ten years of 300,000*l.*, averaging 30,000*l.* a year, that it has no port of importance to compete with to the northward nearer than Londonderry, and to the south than Galway, both towns placed at too considerable a distance to intefere with its trade, while its situation renders it the most suitable market for the sale of the produce of the counties Mayo, Roscommon, Galway, Leitrim, Cavan, Fermanagh, Donegal, and Sligo.

That with such advantages, your Petitioners respectfully submit, they have a strong claim on Government for the aid required, as will enable them to effectually deepen their river, and make their harbour in every respect suitable for all descriptions of large vessels, more particularly steam-boats, which in the present state of the river will not permit any of a large size to work, unless during sping tides.

That Sligo labours under all the disadvantages which must belong to the want of steam conveyance, which has so much advanced the commercial prosperity of almost every other port of the empire.

That the flats before alluded to will only admit steam-vessels of a small size, such as have been already tried and found unequal to the trade, as none but large and powerful boats are suited to contend with the almost boisterous sea, on the north-west coast.

That your Petitioners humbly request your Lordships may be kindly pleased to take your Petitioners case into early consideration, and grant a sum of money for the execution of these works, of equal amount with the bona fide subscriptions of other parties, also a loan of money on the security of the harbour funds, to make up any balance that may be deficient to complete the deepening of the flats, and they confidently hope by steam-dredges ere long to effectually deepen their river, so as to admit vessels of any size, and make Sligo one of the most desirable ports on the north-west coast of Ireland.

And your Petitioners as in duty bound will pray, &c.

BALLYSHANNON HARBOUR.

No. 98.

BALLYSHANNON.

No. 98.
Stevenson, on the Improvement of the Harbour.

Messrs. STEVENSON'S *Report on the Improvement of Ballyshannon Harbour.*

Edinburgh, 15*th June*, 1832.

AGREEABLY to an arrangement made with William Allingham, Esq., secretary to the committee of the gentlemen of Ballyshannon, the reporters visited the harbour of that place, during the spring-tides in the latter end of the month of March last, with a view to ascertain the practicability of its improvement. Having therefore had the honour of an interview on this subject with Colonel Montgomery, Major Bloomfield, and other gentlemen of Fermanagh, a meeting, at which the Reverend Mr. Treddenick and Mr. Atkinson attended as a deputation from Ballyshannon, took place in the Town-hall of Enniskillen, on the 11th of April, the Marquis of Ely in the chair. At this meeting certain resolutions were made, which were communicated to the reporters by L. Baxter, Esq. secretary to the committee of the gentlemen of Fermanagh, directing them to make a survey, and to report "upon the best mode and best line of communication between Ballyshannon and Lough Erne."

The Master-General of the Board of Ordnance was, at the same time, pleased, through the representation of Colonel Colby, to give the reporters access to the trigonometrical survey of this district, which has just been completed under Lieutenant Vicars, of the Royal Engineers. The reporters were by this means greatly assisted in making their professional observations, more especially upon the line of communication between Ballyshannon and Lough Erne.

In reporting upon the objects referred to their consideration, they have to remark that no circumstance connected with the natural history and topography of Ireland is more striking than the chain of navigable loughs by which its surface is everywhere intersected. The improvement of the access to these loughs from the sea would afford the means of increased communication between the different parts of this fertile country, and a more easy conveyance of the produce of the soil, together with all the commercial and economical advantages which would naturally flow from it. This has accordingly been long an object of solicitude with the Government; but although much has been done to obtain this, a great deal still remains to be effected. It is impossible to imagine a more favourable field for this kind of improvement than is presented by the relative position of the seaport of Ballyshannon and Lough Erne. This lake is navigable for craft of about 16 tons burden, throughout its whole extent of 35 miles from north to south, while its entrance is only five miles from Ballyshannon, and its elevation not more than 138 feet above the level of high-water of spring-tides. The lough itself is capable of being considerably deepened and improved at certain narrow passages; and as it lies wholly in the county of Fermanagh, one of the richest districts in Ireland, it may properly be regarded as a medium for the transport of the produce of the neighbouring country toward the sea.

To show the great importance of the district of Fermanagh to the surrounding country, it is deserving of notice, that the Ulster canal, estimated at upwards of 74,000*l.*, has been projected between Lough Erne and Lough Neagh, a distance of 45 miles. It has also been further proposed to connect Lough Erne with the Royal Canal, and thus to form a communication across the kingdom, between Dublin and the western shores of Donegal. To effect the junction of Lough Erne with the sea many schemes have been suggested; but in particular, the formation of a canal from Lough Erne to Ballyshannon, which was long since resolved upon, and, in the year 1789, the Government granted a sum of money toward its being carried into effect. In consequence of this, "The Lough Erne and Ballyshannon Navigation Company" commenced operations near Beleek. But from the difficulties

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and increasing expense attending the formation of a canal in such a situation, together with the disturbed state of the country in 1797, the scheme was at that time abandoned. The failure of this plan was attended with great disappointment, both to the merchants of the towns of Ballyshannon and Enniskillen, and to the landed interest of Fermanagh; and after a lapse of 35 years the subject is now resumed with much energy, and entertained as a most desirable object by all classes in this widely extended district.

The reporters having been called on for their professional advice, are happy in being able to state that after maturely considering the subject, they do not find it necessary to propose any magnificent or precarious plan of operation, nor do they contemplate a very great expenditure in improving the harbour of Ballyshannon, and effecting a communication between it and Lough Erne. Their plan embraces the deepening and partial removal of the bar by certain works of excavation; and, instead of a canal, they have designed a road upon a very easy line-of-draught, which may at any time be converted into a track for a railway.

The town of Ballyshannon contains about 4500 inhabitants, and its harbour holds a central position in the Bay of Donegal, but in common with the other ports on the western coast of Ireland, it is much exposed to the swell of the Atlantic Ocean. It fortunately happens, however, that at Killybegs, on the opposite side of the bay, there is an excellent anchorage, where vessels may ride in security, when they cannot enter the respective harbours for which they are bound. It will be seen from the accompanying small plan of the bar and entrance to the harbour, marked No. 1, that there is a depth of three fathoms water immediately without the bar, which increases to seven fathoms and upwards in the bay, at about 900 yards to the offing. It appears from this plan, that on one side of the harbour the track is through rocky ground; and that, on the other side, it is connected with an extensive sand-beach. The depth upon the bar, and the navigable reach up to the town, is kept fully open by the combined action of the river Erne, and the flux and reflux of the tide. Some idea may be formed of the power of this stream, from its being the only outlet of the extensive lake of the same name, and from its draining the whole district of Fermanagh. It has been estimated to carry down not less than 400,000 tons of water to the sea every hour. The tide, however, is considered a still more powerful agent in scouring and keeping the bar open, as the tidal waters pass over it four times in the course of every 24 hours, filling and emptying the great basin of the harbour, extending over a superficies of about 606 imperial acres.

The outfall of the river Erne, which forms the entrance to this harbour, in so far as it has been practicable to explore it, is fortunately found to consist of somewhat hard and firm ground, and is therefore not so liable to shift and change as if the water had flowed over a sandy bottom. The bar itself lies between what are called in the plan the North and South Rocks, lying about 150 yards apart; and the depth upon it at low water of spring tides is from four to six feet. But the pilots and mariners of the port complain more particularly of the rock called the Patch, which lies considerably within the bar, as will be seen from the depths of water marked on the plan. This patch or band of rocky ground extends across the river, and at low water of spring tides there is only a depth of about two feet upon it. To this, 10 feet for the rise at spring-tides must be added, in order to give the available depth on which vessels calculate in entering this port. After passing the Patch the water deepens; and from the Forest-rock to the quay of Ballyshannon, a reach of 2¼ miles, vessels lie in perfect safety, with a depth of not less than from 15 to 20 feet at high water. The reporters, therefore, propose to deepen the bar and Patch to the extent of about three feet; by which means vessels drawing 14 or 15 feet may enter in spring-tides, and thus an extensive and useful class of trading vessels, which now are either wholly excluded, or whose entrance is rendered very precarious in the present state of things, will have ready access to the harbour.

This operation, as formerly noticed, involves no experimental scheme or expensive works of preparation. It has for its recommendation that it has already been acted upon to a certain extent at Ballyshannon many years since; and that now, as then, however small a part be executed, some corresponding benefit in deepening the bar necessarily follows; nor can its failure deteriorate the present channel, or incur any ruinous expenditure, as might be the case were extensive walls of masonry to be built, and put to hazard in so exposed a situation. The reporters conceive that the work may be effected by a train of steady and active exertions in blasting with gunpowder, and removing masses of rock. For this purpose it will be necessary to provide a suitable establishment of boats, lighters, cranes, and other implements, agreeably to a digested and specified plan of operations, which must be conducted at the sight of an experienced and active resident superintendent. The whole expenditure will therefore consist chiefly of labour, and the provision of the necessary apparatus for the superintendent and his workmen, or contractors, as the case may be.

Besides the bar and Patch, it is proposed to remove part of the black rock and the ledges connected with the beach; which last will give employment to the workmen at times when the low water works are inaccessible. The chief difficulty to be contended with in this operation arises from the strength of the current, which runs from the great basin of the harbour to the sea, on the one hand, and from the heavy surge and breakers of the ocean, on the other; both of these occurrences must frequently interrupt the works, and endanger both the workmen and their apparatus. To lesson these, it may be found necessary for a time to produce some change in the current of the river; but this will better appear in the progress of the works. From these untoward circumstances a degree of uncertainty must attach to every opinion regarding the time and outlay required to complete a work of this nature; but the reporters calculate that the operations will occupy three seasons, and they estimate that the sum of 5561*l*. 2*s*., including 20 per cent. for incidents, will be required, agreeably to the annexed estimate.

To avoid the difficult operation of deepening the bar, some have proposed to cut a direct passage for the river through the sand-hills and the beach or ebb, which is left dry at every tide. The great objection attending such a plan does not lie in the operation, but in the difficulty and hazard of preserving a navigable track for vessels after the cut has been made, owing to the shifting and uncertain nature of such extensive sandy beaches. On several occasions the river has made a passage for itself on the south side of the Patch, but the channel has as often been shut up by the heavy surge from the Atlantic. There cannot, therefore, be any permanent outfall for this river or entrance to this harbour, excepting on the hard ground which it now fortunately and naturally occupies.

Others in quest of the same object have proposed to form an entirely new harbour at the small bay or creek called Bonatroohan, which will be seen upon the general plan, marked No. 2, and is situate about 1½ miles to the northward of the mouth of the river. Agreeably to this view, a navigable canal was also to have been formed, of about two miles in length, across the neck of land from Bona-

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troohan into the basin of the harbour, at or near the place marked "Boat-house" on this plan. The reporters have no hesitation in stating that, although such a train of works may be considered practicable, yet it would by means be eligible. To form a harbour for sea-borne ships at Bonatroohan, and connect it with the basin of Ballyshannon, would be a work of great magnitude, and would require a corresponding expenditure. So far, therefore, as the harbour works are concerned, they are disposed to confine them to the improvement of the present channel, and ultimately extending the berthage or quay accommodation along the ground to the north-westward of the present quay, as marked in red lines upon the general plan. This extension of the quays they have estimated at 397*l.* 2*s.*

Before leaving the subject of the harbour, the reporters beg to bring the following facts under the notice of the committee in relation prospectively to the funds required for these works. It appears by an official return from the Custom-house at Ballyshannon that, from the difficulty of access to the harbour, there have, in the course of last year, only 61 vessels been entered coastwise, and 12 foreign, or in all 5600 tons. Now a tonnage-duty of 1*s.* 3*d.* on the vessels and also on goods in full of port charges (even in the present circumscribed trade of the port), would produce about 350*l.* per annum, which at 3 per cent. would pay the interest of 11,666*l.* 13*s.* 4*d.* It may withal be remarked, that this is only about two-thirds of the tonnage-duty chargeable at Portrush, situate upon the same line of coast.

There cannot be any doubt that the most desirable method of effecting a communication between Ballyshannon and Lough Erne is the extension of an inland navigation between the lake and the harbour. The small craft which at present trade upon Lough Erne would thus load at the sea borne vessels' side, and at once carry their burdens to the interior, and *vice versâ*, without the disadvantages attending a change of carriage and reshipment. But this object, how desirable soever, must be considered nearly unattainable. The improvement of the river for the purposes of navigation is utterly impracticable, and the formation of a canal would be a work of enormous expense. The number and height of the rapids and falls which occur between Beleek and the sea must render abortive every attempt to navigate this powerful stream. But no one can regret the existence of these falls, which may be regarded as immense storehouses of mechanical power, capable of giving impulse to unlimited trains of machinery; and, instead of exporting grain from this district to be ground in other quarters, as at present, we may hope, by the application of these waterfalls, to see it exported in a state ready for the use of the consumer. It is, indeed, one of the most striking proofs of the want of proper communication under which this district labours, that, perhaps, the finest waterfalls in the United Kingdom, though in the immediate vicinity of a sea-port, are allowed to run waste, and have never been applied to any purpose, excepting in the recent instance of a distillery at Ballyshannon. With regard to the formation of a canal, the reporters remark that, in the year 1812, the late eminent Mr. Killaly surveyed and estimated a work of this kind from Lough Erne to Ballyshannon. The estimate for this work, independently of any improvement of the harbour, amounted to 63,000*l.*, and Mr. Killaly himself again confirmed his former views of the expense in 1831. The late Mr. Chapman, also an engineer of celebrity, made a survey for a similar purpose; but the reporters have not been put in possession of any documents respecting his plan. It is enough for them to say that, after a very careful examination, and making various sections of the country, they feel no disposition to lessen the estimate of Mr. Killaly, as along the only line in which such a work is practicable the ground is one mass of limestone rock, with a very thin alluvial cover.

In these circumstances the reporters propose the formation of so very perfect a line of road as to be at once easy for the draught, and which may at any time be readily converted into a railway, suitable either for horse-power or the locomotive engine. But as a progressive improvement seems to be more suitable to the present state of this district than any forced and expensive mode of conveyance, they would suggest that, in the first instance, the road should be opened for the common traffic of the country, as now carried on. In this way the benefit of the improved communication would be more directly felt by those at moderate distances from the margin of Lough Erne than by means of a railway or canal, both of which would induce an interchange of carriage.

It will be seen from the general plan on which the proposed road is delineated in red colour, that its line of direction is very straight, the whole length being only five British miles. The section delineated on this plan also shows that its line-of-draught is extremely easy, being nowhere worse than 1 perpendicular to 120 horizontal. This acclivity is quite suitable to a locomotive engine, and is indeed considerably better than that of the inclined plane at Rainhill, on the Liverpool and Manchester railway, which rises at the rate of 1 in 96. For nearly two miles the proposed line of road is quite level; and the reporters are of opinion that the light horses of the country, along such a road, will draw 2 tons (2 tons 7 cwt.) upon a good common cart or waggon.

This road, as will be seen from the section delineated on the plan marked No. 2, commences with a pretty deep cutting upon leaving the harbour. It then, by means of a small bridge or tunnel of 60 feet in length, passes under the road or principal street of Ballyshannon, immediately above the barracks, and follows the north bank of the river Erne pretty closely, till it passes the village of Knather on the south. It leaves the house of Laputa also on the south; and, making a very gradual turn, it passes through Mullens, and crosses the river Erne by a bridge of four arches, with 200 feet of waterway at a turn or shoulder, where the river suddenly contracts opposite Cloughore. This bridge is estimated to cost 2423*l.* 6*s.* After crossing the river, the line turns a little to the south, then passing the burying-ground of Cloughore on the west, it again reaches the river. From the precipitous and difficult nature of the banks immediately below Beleek, it becomes necessary to cross the bed of the river by two embankments, which together extend only to 133 yards. To effect this, a new cut must be made for a small portion of the course of the river, but this is a work of no great difficulty, the expense of which is estimated at 1466*l.* 12*s.* This work will supersede the formation of a very expensive tunnel, or some great work of excavation, which the high ground would render necessary if the line were carried along the south side of the river. A sharp turn is also thereby avoided, and the upper part of the line on the whole very much improved. After crossing the river, the line reaches the public road at the southern end of the bridge, and eastern side of the fort, and terminates at the quay of Beleek, on Lough Erne. An offset can also be easily made to form a communication with the town of Beleek and with the opposite or northern side of the lake.

This very eligible line of road fortunately incurs very little interference with, or injury to, valuable private property. It passes almost entirely through rocky ground. In preserving its line of draught, it necessarily induces cutting to a considerable extent. But the cubical contents in rock cutting in the formation of a road, under similar circumstances, is always considerably less than in earthy matters, where the excavation required in making sufficient side-slopes often greatly exceeds that of the main track of the road itself.

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To provide the necessary funds for these road operations, and for the maintenance of this line of communication, a toll or duty will require to be laid upon the traffic along it, for which a scale may be formed agreeably to the principle and data noticed for the tonnage-duty and harbour-dues, in the preceding page of this report.

In order to avoid some of the works on this line, the reporters endeavoured to cross the river at the harbour or quay of Ballyshannon, and so to keep on the south side of the river all the way to Beleek; but, after a careful survey in this direction, the ground was found to be very unfavourable for a line of road, both in point of direction and draught. Another line was also tried by keeping upon the north side of the river for about three-quarters of a mile above Ballyshannon, crossing near Ballyhanna, and then proceeding on the southern side to Beleek; but this was found to be quite impracticable, without passing through valuable private property in a manner highly objectionable, or otherwise rising to such an elevation at the summit of the road as to produce an undulating line-of-draught, with a very curved line of direction.

Upon the whole, the reporters have no hesitation in giving their decided preference to the line which they have delineated in red colour upon the general plan. The expense, as appears by the annexed estimate, of forming a road by this line upon the most approved Macadam principle, is 18,133*l.* 4*s.* 9½*d.*, including 10 per cent. for incidents. If this road be afterwards converted into a double-track railway, the additional outlay will be 10,641*l.* 0*s.* 1*d.* The expense, however, of at once constructing a railway in the line above recommended is estimated at 26,693*l.* 5*s.* 0*d.*

The improvement in the navigation of Lough Erne is deservedly an object of much attention in connexion with this general measure. But, as before noticed, the deepening of the entrance of the harbour of Ballyshannon should take the lead of every other work.

The reporters cannot take leave of this subject, so intimately connected with the prosperity of a rich and populous district, without pressing upon the attention of their constituents some few important considerations. The ultimate success of any measure for facilitating the communication of Lough Erne with the sea depends wholly upon its connexion with an accessible harbour. The reporters consider that they have informed themselves sufficiently of the localities of the shores of Donegal to be able to say, that Ballyshannon is not only the natural but the most accessible point of communication with Lough Erne. Its nautical disadvantages are capable of being greatly improved, while its distance from the lough is the shortest possible to the sea. As no internal intercourse, however perfect, if comparatively distant and prolonged, can be of much benefit to the district from which it proceeds, so neither will a communication, however short, be of much utility if it does not possess a proper outlet for the produce of the country at some flourishing sea-port. It is only by this combination of easy communication and a well frequented port that the commodities of a country can rise to their true value, and a proper equality of price between the exports and imports be firmly established. To improve the entrance of Ballyshannon harbour, then, appears to be the first and most important object of this general measure; and as the interest of all parties is equally involved in it, the reporters beg to call the attention of both Committees to the propriety of uniting their efforts, in the first instance, to this one object. If the merchants of Ballyshannon be more immediately interested in the prosperity of that port, those of Enniskillen and the proprietors of the upper country are ultimately no less dependent on its improvement for the success of every measure which, by facilitating the means of intercourse in the district round Lough Erne, must necessarily better their prospects and raise the value of their estates. The whole sum required for improving the harbour of Ballyshannon, and forming a communication with Lough Erne, amounts to 24,091*l.* 8*s.* 9½*d.*, agreeably to the annexed estimates.

ROBERT STEVENSON.
ALAN STEVENSON.

To the Most Noble the Marquis of Ely,
&c. &c. &c.

ESTIMATE of the EXPENSE of Improving the HARBOUR of BALLYSHANNON, and of forming a Communication with Lough Erne, agreeably to the Plan proposed in the foregoing Report.

IMPROVEMENT OF THE HARBOUR.

	£.	*s.*	*d.*	£.	*s.*	*d.*
For providing lighters, punts, boats, anchors, and cables, together with tools and implements, for the various operations in improving the entrance of the harbour . .	1,150	10	0			
For building a house for the superintendent, erecting workshops, and enclosing a work-yard near the entrance of the harbour	300	0	0			
For superintendent's salary, including premiums for extra exertions during four years, the supposed duration of the works, estimated at 150*l.* per annum	600	0	0			
For foreman's salary, exclusive of house accommodation, for three years, estimated at 55*l.* per annum . . .	165	0	0			
For wages of workmen during three working seasons, at an average outlay of 5*l.* 7*s.* 6*d.* per day for 450 days . .	2,418	15	0			
Incidents, at 20 per cent.	926	17	0			
Improvement of Bar				5,561	2	0

QUAY WALL AT BALLYSHANNON.

	£.	*s.*	*d.*	£.	*s.*	*d.*
For building a quay-wall 600 feet in length to the northward of the present quay of Ballyshannon, from materials got from the road excavations	361	0	0			
Incidents, at 10 per cent.	36	2	0			
Quay Wall				397	2	0
Total for the Harbour				£5,958	4	0

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COMMUNICATION OR ROAD.

Earth Works.

	£.	s.	d.	£.	s.	d.
For 134,515 cubic yards of excavation in rock along the whole line, taken at the rate of 1*s.* 6*d.* per cubic yard, on account of the low price of labour in this district, and the application of part of the stuff to other purposes of the work	10,088	12	6			
For 17,777 cubic yards of excavation in forming a new channel for the river Erne, two embankments near Beleek, 1*s.* 6*d.*	1,333	5	6			
Earth Works				11,421	18	0

MASONRY.

	£.	s.	d.	£.	s.	d.
For a bridge or tunnel under the road near the Infantry Barracks of Ballyshannon	449	13	0			
For a bridge of four arches over the river Erne, opposite Cloughore	2,523	6	0			
For 238 lineal yards of cross drains along the cuttings, 2 feet square in the clear, 7*s.* 9*d.*	92	4	6			
For 36 lineal yards of tunnelling, 6 feet in span and 6 feet high, for conveying Mullens Brook under the embankment, 35*s.*	63	0	0			
For 14 lineal yards of tunnelling, 3 feet span and 3 feet high, for conveying Knather Brook under the embankment, 15*s.*	10	10	0			
For enclosures and gates along the line, estimated at	500	0	0			
Note.—From the nature of the works and the country passed through, the extent of enclosure required is limited in this district.						
Masonry				3,638	13	6

ROAD MAKING.

	£.	s.	d.	£.	s.	d.
For 11,817 cubic yards of broken limestone, laid to the breadth of 16 feet and depth of 9 inches along the whole road, 2*s.*	1,181	14	0			
Note.—The price of this item is low, because the whole metal will be got from the cutting, so that quarrying is not here included.						
For 5268 lineal yards of road forming and dressing through the cuttings, before laying on the metal, 6*d.*	131	14	0			
For 3595 lineal yards of road forming and dressing through the embankments, 3*d.*	44	18	9			
For 5268 lineal yards of sky-drains through the cuttings on both sides of the road, 2*d.*	43	18	0			
For 2634 lineal yards of catch-water drains along one side of the cuttings, 2*d.*	21	19	0			
Road-making				1,424	3	0
Incidents, at 10 per cent.				1,648	9	6½
Total for the Road				18,133	4	9½
Total for the Harbour				5,958	4	0
				£24,091	8	9½

LONDONDERRY.

No. 99.

Evidence taken on the 26th Sept., 1845.

No. 99.

PORT OF LONDONDERRY.

Examining Commissioner, Capt. WASHINGTON, R.N. and F.R.S.

Present:—the MAYOR, SIR ROBERT A. FERGUSON, Bart., Mr. J. LEATHEM, Mr. G. FOSTER, Mr. W. MCINTYRE, Lieut. RAMSAY, R.N. Captain COPPIN, &c.

Mr. CHARLES STEWART, as deputy vice-admiral under the Irish Society, put in several documents to show the right of the Society in the river and lough, and their jurisdiction over the same and the adjacent coast; also to appoint a deputy vice-admiral, and their authority for making Derry a port. He also produced the Act of 2nd and 3rd Wm. IV. c. 107, by which the Ballast Office for this port was re-constituted, and it was empowered to act as conservators of the navigation, but under reservation of the rights and privileges of the Society. Could not readily answer the question how far the Society could control the Ballast Office in the exercise of their powers; the Society could not run out a pier into the channel; their powers do not extend beyond low-water mark; the Ballast Office could control the Society, if they did what was injurious to the navigation.

Mr. STEWART, clerk to the Ballast Office, examined.—Two members of the Ballast Office go out annually, and their places are filled up by the votes of the ship-owners; three and five of the body, respectively, form a quorum; they give directions to the pilot-master and harbour-master; they have received complaints from the ballast-master as to the navigation, but did not forward them to

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the Speaker of the House of Commons in consequence of its order; they were verbal reports rathe than complaints; they referred to erections having been run out into the river; counsel's opinion was taken about two years ago on the subject, but no proceedings instituted thereupon; the Ballast Office have no stated meetings, but it is convened when there is particular business to transact; the average number of their meetings may be about one monthly; their accounts are audited yearly by a committee of ship-owners, and published; there has been no complaint as to the expenditure; buoys and beacons are in progress of erection along the lough and river in consequence of a report made to the Office.

CHARLES STEWART, Esq. (as harbour-master) examined.—Has known the lough and river for 45 years; the entrance to the lough and the lough itself, up to Ture, are the same as ever they have been since witness knew them; at Ture it has got shallower, but there, at the shallowest, which is the Flats, it has been deepened two feet by the action of the paddle-wheels of steamers; when he was a boy it was seven feet, and it is now nine; above that there has been no change for the better or the worse; at Derry they have a fair rise of nine feet of tide, but with a N.E. wind and a fresh it may rise 12 feet; does not think that by steam dredging a depth of 12 feet could be gained at the flats, and that depth maintained without continued dredging; a steam dredge might be of use in gaining several inches; they have a hand dredge at the port. There have been several projections into the river for the discharge and shipment of goods, both above and below the public quays, where vessels of 800 tons discharge; there was no permission given for those projections by the Ballast Office; does not think that they have injured the public quays; there was once more water at the foot of Mr. Munn's quay than there is now; there was once five feet there, but there is none now at low water; as harbour-master he has repeatedly complained of projections, but no notice was taken of them beyond obtaining the opinion of counsel; there has been no marginal line prescribed for the river; the Society leased out to low-water mark only; there are some projections also on the other side of the river.

By the MAYOR.—At witness's suggestion, in the time of the old corporation, the Society authorised the construction of a dry stone wall, which was meant to be a marginal line, but individuals carried out their works beyond that without any permission; does not think that the projections near to the bridge have thrown the current towards the other side; thinks that the deposit at Mr. Munn's consists principally of ballast and rubbish thrown overboard by sailors. Don't believe that the ground from which those projections have been run would have sold near so high but for the chance of obtaining the privilege of making them; the wants of steamers require these. A proper engineer ought to have been called in for his opinion before the works were effected, but that was not done; thinks that opposite to the middle (public) quay there has been a filling up of eight feet; at the wooden wharf there is now the same depth as was formerly. If the quays on this side have the effect of throwing the current over to the opposite side, the quays on that side ought to have the same effect as to this; never considers the tide as flowing above Lifford; the tide flows here at the rate of three miles an hour, but the ebb tide is stronger; considers the erections on the opposite side at the end of the bridge, by several individuals, to be encroachments; the Society have here leased to low-water mark; the ground there was taken in by the Society as a landing place for the convenience of the public; a small toll is levied for this, but it has been of no profit to the Society.

Sir R. A. FERGUSON here observed that he believed that the old corporation erected this landing place by the sanction of the Society, to whom it reverted by purchase after the difficulties of the corporation came on. About 1760, the water on this side came much nearer to the walls; and a grant of money was then obtained from the Irish Parliament for enlarging the quays, by which much valuable ground was gained.

WITNESS—Thinks the pier at Culmore has caused an eddy in the bay there, which again may have caused a deposit. At the mouth of the lough there is a ridge of six feet, but the largest vessels may come up to Moville at any time; considers that the lough may be made most valuable as an asylum or harbour of refuge; there is no harbour on the coast that would serve that purpose, for vessels of 1000 tons, nearer than Belfast; ships could get repaired in this port, where there is a patent slip, but it would be better were it larger. There are sufficient lights at the entrance, but commercial men complain of the difficulty of distinguishing the inner from the outer light; there is a line of railway to pass over the lough, but can't say what effect it may have on the navigation; thinks an engineer and sailor ought to have been consulted regarding it.

Sir R. A. FERGUSON stated that, before the railway bill passed, parliament had authorised the embankment of the slobs, and there had been an elaborate report on the subject by Mr. Walker, who acted by orders of the Admiralty.

WITNESS.—Some of the pilots were consulted with regard to the effects of the railway; parliament gave them a straight line to Magilligan; witness could wish to see a sufficiency of water to act as a scouring power upon the Tons; they are much the same as they ever were: there have been two buoys placed there by the Ballast Office, and a bell buoy has been recommended; there have been very few wrecks at the entrance of the lough; perhaps there have been three during his recollection; has known a great many vessels at the same time running to the lough for refuge, and remaining there wind-bound.

Mr. CHRISTOPHER FORREST, captain of the "Sea Nymph" steamer, examined.—Before he got command of the "Sea Nymph," he commanded for seven years a sailing vessel which traded with this port; within his time the Flats have been deepened a little by the steamers; a steam dredge would deepen them greatly, and the depth might be maintained without further dredging; thinks that the embankment of the slobs will benefit the channel, as the tidal influence will be increased by it, and that the whole of the great bank might be enclosed with advantage; thinks that there has been a decrease in the channel opposite to all the quays, and that it has been caused by projections into the river; a straight line of quays would not have had that effect; the opinion of all the ship-owners and captains is, that the channel has been narrowed opposite to the quays: witness never found any difficulty in taking the lough; it is well adapted for a harbour of refuge; has seen upwards of 50 vessels at a time taking refuge in it—some at Moville, others at Quigley's Point; vessels could run in day and night, were it properly buoyed and lighted; witness came up last night, and has come up other nights, by the aid of temporary experimental lights; it would be better if the two Ennishowen-head lights were on different elevations instead of being on one.

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Mr. STEWART, the harbour-master, stated, that the Ballast Office here had, about two or three years ago, applied to the Ballast Office of Dublin about these lights, but nothing had been done since then.

WITNESS—Conceives that a light at the Skerries off Portrush would be of great use; the one nearest to it eastward, on the Irish coast, is the Maidens, and the nearest on the Scottish is the Mull of Kintyre one; has known three wrecks on Rathlin within four years, owing to the want of a light; there should be a larger buoy on the Tons, and one in the south channel, where there is a depth of about 12 feet at low water, and vessels very frequently take it; there is a very dangerous rock, called the Kinhane, off the Antrim coast, where a buoy or perch is much wanted; believes that a Derry steamer ran upon it and received much damage; has made representations to the Ballast Office of the want of buoys; the traffic of the port has very much increased, and will increase more, owing to the railways; and every effort ought to be made to improve the navigation, particularly near to the quays.

By Mr. JOHN LEATHEM.—Thinks the current is stronger at Culmore than at the quays; the tendency of a stream in its natural state is to deepen on the concave side, and to deposit on the convex; thinks it is desirable at Derry to narrow the channel, so as to increase the rate of current there to what it is at Culmore; were there a uniform line of wall from the Gallows Strand on both sides of the lower end of the quays, the velocity of the current would be increased, and deposits prevented; thinks that the river at Derry is too narrow for a vessel to swing properly.

Mr. MICHAEL M'MULLEN, quay-master, examined.—Has known the port for 60 years; there has been a great decrease of water in front of the public quays, particularly the middle one; they are cleansed out mostly once a year; within his recollection the present quays were run up by the corporation; there has been no great increase of deposit within the last few years; there are not more than six feet of water at the middle quay, where there used to be eight; the projections above the public quays cause no deposits but what goes into the docks.

By Mr. JOHN LEATHEM.—The water in front of the new quay, where the old wooden wharf was, is as deep now as he ever recollects; the north quay has not much filled up, if anything; the filling up to which he alluded is at the middle quay; is not prepared to say whether that quay would fall within a straight line from the new to the north quay; if it do so fall within, it would account for the filling up; the fronts of the quays, as well as the docks, were dredged when he knew them first; dredging is not so frequent now as it was in the time of the old corporation; the fronts have not been dredged lately; mud, pressed out from the docks by the vessels sitting down in it, might account for the filling up at the middle quay.

CAPTAIN COPPIN examined.—Has been professionally acquainted with the Lough and harbour these last 15 years; during that time the Flats of Ture have been deepened by the action of the steam paddles; a steam dredge would still further deepen them, and the depth would be maintained; has often stated this to the Ballast Office.

Sir ROBERT A. FERGUSON here observed, that the pecuniary embarrassments of the corporation had deprived the Ballast Office of their funds, and that it was not till last year that they had come into possession of any.

WITNESS—Believes that the proposed embankment of the slobs for the railway will be of great benefit to the navigation, and cause a greater depth of water at the quays; has no fear of its causing a deposit at the entrance of the lough: the current there would drive the Tons back, and widen the entrance; at Magilligan there are more than five knots of run, which is too much, and conceives it to be owing to the great rush of the tide to fill up the slobs; in Lough Swilly the tide is nearly two feet higher than in Lough Foyle, which must be attributed to its having a much larger entrance than Lough Foyle: the spring tides in Lough Swilly are, at Buncrana, 15 feet, and outside of Magilligan they are not more than 7½ feet; has more water at his own quay than he used to have, and the current there is very good, which may be owing to the works above; at Mr. Mnun's old wharf there is not the same depth there used to be, the cause of which he thinks is the deposits caused by the action of paddle-wheels: the public docks within the line of the quays accumulate a deal of mud, and they have become of little use but for lighters and other small craft; in heavy gales there is no difficulty in lying at the quays; knowing the Lough, he would take it in a steamer or sailing vessel either by night or day, but with a stranger the lights at Innishowen Head are more apt to mislead than to guide; there was no light there before them; he had nearly lost the "Queen Adelaide" there from the want of a light; they paid the same light dues then as they now do. Witness thought a light was much wanted on Rathlin; in fogs it was difficult to distinguish between it and the mainland; on Kinbane rock a perch was also much wanted, and at the Tons there should be a bell buoy: it is not particularly foggy on this coast; it would be better if all the buoys at the entrance were larger; were the lough properly buoyed and lighted, he would prefer coming up or down at night, and he would come up or down in any hour of the tide, with a vessel drawing only nine feet.

By Mr. JOHN LEATHEM.—The spring tides at Derry rise nine feet; any vessels not over 200 tons may swing there; for vessels beyond that it might be unsafe to do so; thinks that narrowing the river would improve its channel; keeping its velocity at the town equal to what it is above would be an advantage, and an unbroken sea-wall on both sides would be a very great improvement. The embankment of the slob at Kilderry would improve the channel; Mr. Heming's embankment for the railway will have the same effect, and raise the tide up to Derry.

Lieut. RAMSAY, R.N., Government Emigration Agent, examined.—There has been no improvement in the navigation of the river since he first knew it; the deposits at present are all on the north shore; the projections into the river below the bridge are hurtful to the channel; a continuous quay in a straight line would do it much good; thinks that the embankment of the slobs for the railway, if in a straight line, will improve the channel; accompanied Mr. Smith, who acted under Mr. Walker, employed by the Admiralty, in his late survey of the lough, down to Magilligan, and it occurred to him that the more the embankment approaches the channel, the better will it be for the channel; steam dredging would improve the channel at the flats, after which it would keep its depth; vessels of 18 feet cannot come over the flats excepting at spring tides.

Sir R. A. FERGUSON stated, that the quayage dues were never applied to the uses of the harbour, as they were only levied at the quays, which formerly belonged to the corporation, and were now private property. And Mr. WILLIAM M'INTYRE explained that only ships with foreign (not colonial) cargoes were made to discharge at those quays; that no quayage was chargeable at the quays con-

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structed by private individuals; and that the tonnage dues alone, which had been almost doubled within the last year, were all that were applied to the maintenance and improvement of the harbour.

WITNESS.—Before there were lights at Innishowen Head, had seen two wrecks upon the Tons; these lights were of no use to those inside the entrance; suppose these to be in one, a person then could not say whether one or two were burning. A light on the south point of Rathlin is much needed, and would not interfere with the light at the Mull of Kantyre; the rock off Kinbane ought to have a perch or beacon; there are not many fogs here, but larger buoys are wanted on the Lough and river.

Mr. STEWART GORDON, county surveyor, examined.—Knows the river from Lifford downwards; 13 or 14 years ago about 40 acres were taken in from the river at Grange, six miles above Derry; there are a number of projections into the river at Derry on both sides; they obstruct the tide, and cause deposits in the interstices; a small jetty might change the direction of a whole current; there should be even lines of quayage along the sides; the Derry and Coleraine line of railway is to be run along at low-water mark; its directors must have a continued sea-wall from its terminus at the water-side, and across Ross's Bay; this would be an improvement of the channel; it will be necessary to keep the river at Culmore very clear; if the channel at the flats be opened, the embankment of the slobs, aided by dredging, will keep it clear, but it may cause a small deposit outside, though of no injury, as there it is so deep; as the same quantity of sea water will be received into the Lough as before, it will have the effect of increasing the height of the tides; should there be a regular sea-wall or quayage at the town, the effect will be both to keep the channel clear, and to afford to the public convenient access to the river, which is very much required; thinks that the great depth of the river at Derry, and down to Culmore, is produced by freshes, and that below Culmore the depth is affected only by the tidal water; at present the tide rises higher at Derry than at Ballykelly, where it has a large basin to fill. Excepting at the Gallows Strand, the Derry and Enniskillen Railway will not interfere with the navigation, and at that point will do no injury; at present the piers at Derry are in tolerable condition.

Mr. JOHN LEATHEM observed, that it might be as well to state the impression made upon his own mind, and that of the merchants now around him. They understood Mr. Gordon and the captains who had been examined to state, as their opinion, that the river and harbour would be improved by an unbroken sea-wall being carried outside the existing yards and wharfs from the bridge downwards, and he thought he might say that there was not a merchant in the room who did not assent to that opinion.

Mr. CHARLES STEWART, re-examined.—A considerable number of years ago, an officer of the coast guard at Innishowen was appointed by his Board to take tidal observations, and did so for a month or more; there are two hours of difference as to time of high water at Innishowen Head and Derry; it is an eddy tide from the eastward, which first begins to fill the lough before the regular tide sets in; does think that greater depth could be obtained at the flats by dredging, but that to maintain that depth occasional dredging would afterwards be necessary.

Mr. JAMES M. DAID, pilot, examined.—There are 29 pilots on the lough and river, appointed by the Ballast Office; the appointment takes place after an examination by the pilot-master, ship-masters, and pilots, before the Ballast Office committee, and they are paid for each vessel by the drought of water. The channel at the flats has been deepened by the paddles of steamers at low water; a steam dredge would deepen it still further, and no effort would be required to maintain the depth. Was Mr. Bull's assistant in boring the channel. The rate of the tide at Coneyberry is 3½ knots, at the flats, 2½, at the entrance of the lough, 4½, and at the quays, about 2½; there might be an inconvenience in dropping a ship near the quays, were the rate of the tide to be increased there by a knot. The pilots at their stations have yawls; there are rather too many pilots in ordinary times, but when there are westerly winds and neap tides there are few enough; a stranger could easily run for and take the port, but the two lights at Innishowen Head, being of the same elevation, might confuse him. He would suggest the placing of a larger buoy on the tail of the Toas, though it would not be seen in a dark night.

Mr. EDWARD M'GEEHAN, pilot, examined.—Concurred generally with the preceding witness; thought that the depth to be obtained at the flats by dredging could be easily maintained, as the water both above and below is deeper than there; this dredging, and the buoying and lighting which are now going on, are the only improvements in the lough and river that he could suggest; they would enable vessels to go and come at all times; there is a bend in Ross's Bay, called Madam's Bank, opposite Boomhall, which ought to be cut away; the tide does not run fair over the angles and banks on the Donegal side of the Lough, below Culmore, and any embankment on that side, below Coneyberry, would be of no use in improving the channel, if not carried down to Ture Point. Where a large vessel has set down in the flats, she has formed a dock for herself, which has maintained its form for a considerable time.

Mr. SAMUEL HEMMING, engineer, examined.—Is quite satisfied that the depth to be procured by dredging at the flats would maintain itself. Produced plans of the river and of the proposed embankment for the railway, and stated that the sanction of the Admiralty to the line fixed upon for that embankment had been obtained.

No. 100.
Walker, on the proposed Improvements of the Foyle Navigation.

No. 100.

Mr. WALKER, *on the proposed Improvements of the Foyle Navigation.*

SIR,

23, *Great George-street*, 23*rd July*, 1841.

In compliance with the directions contained in your letter of the 26th May, I proceeded to Lough Foyle so soon as I had received from the parties applying for the approval of the Admiralty to the proposed embankment, the plans and information necessary to enable me to understand the intended work, and to judge as to the extent that might be permitted without prejudice to the navigation of this fine Lough, or to the trade of the district, particularly that of Londonderry, which is situate on the river, about five miles above the head of the Lough.

It is now my duty to report my opinion.

You are probably aware that by an Act of Parliament passed in 1838, power is given to embank a portion of the Lough, that is, between high and low water, subject to the previous approval of the lords of the Admiralty.

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No. 100.
Walker, on the proposed Improvements of the Foyle Navigation.

As it is very difficult to lay down a line for embankment which can be strictly adhered to in the execution of the work, I have thought it better to give one as a limit, beyond which, if approved, the projectors may not go. My opinion of this limit is shown by the red line upon the accompanying plan; it is to the full extent of the wishes of the projectors as explained to me, and as shown by the dotted line, and very considerably beyond what they propose to execute at present. I consider that if the ground is not useful for navigation, to reclaim it for cultivation is doing a public good; and if ever the time arrive when the successors of the present projectors desire a still further extension, the matter should be viewed upon its then merits; it will probably be long before this takes place, but the tendency of any partial embankment, where there is no current, is to allow deposit in front of it; therefore it is not impossible that an application similar to this, for a further enclosure, may one day be made, and that a compliance therewith may not be injurious.

The evil to be guarded against in these cases is a diminution of depth, not opposite the embankment, but at the entrance of the Lough, by lessening the quantity of tidal or back-water, which every enclosure of land lying between high and low water has the tendency to do. In the present case, the depth of the entrance, caused by the contractor there, is already so great, that no evil of this kind is to be dreaded from the intended embankment. I beg, in proof of this, to refer to the Admiralty Chart of the Lough, from Capt. Mudge's survey of 1833; it will be seen that the low-water depth in every part is 24 feet at the least, and generally double or triple that depth. It, however, appears to me requisite for the public protection, that whichsoever of the three distinct portions shown upon the plan be begun, some security should be given that such portion should be finished; for after throwing up banks and facing them with stone, as is intended, the abandoning of the work and leaving the materials to be scattered about might become a nuisance, and render the navigation of the Lough dangerous for small vessels approaching them.

The whole, as appears upon the plan, is necessarily divided into three parts by the outlets required for the passage of the river Roe and the Ballycally canal, and, in each division the greatest distance from the land to the line of embankment, or the breadth of the land reclaimed, is about two miles.

	Acres.
The contents of the western division, marked A on the plan, taking Mr. McNeil's measurment as a basin, is	7000
The middle division, namely, between the river and the canal, marked on the plan B, is	4000
And on the eastern, C on the plan	7000
The small piece on the north side of the Lough, opposite to Kildeny, D on the plan	200

But the lines, not the quantity, are the proper guides.

I beg therefore, in accordance with the foregoing observations, to recommend that the approval of the board be given to embanking to the extent shown by the red line upon the plan, subject to the stipulation I have made.

I have, &c.,
J. WALKER.

To Sir John Barrow, Bart.
&c. &c. &c.

P.S. I beg to add, that on my arrival I found some hundreds of men at work upon the middle, division B, (Mr. Robertson's); they had abandoned a line in front, which they had commenced, and had retired further in. The irregularity in the abandoned work should be levelled in again for the reason stated in the report.

No. 101.

Mr. W. BALD's *Report on the Improvements of the Foyle Navigation.*

No. 101
Bald's Report on the Improvements of the Foyle Navigation.

GENTLEMEN, *Glasgow, September*, 1844.

I beg leave to report, that I have examined the plans and sections of the flats between Culmore and Ture, made under my directions, with a view to the improvement of the navigable channel between the Faughan Foot buoy, and the Ture buoy.

I have delineated on drawing No. 1, the proposed improvement of the existing channel by deepening, and which channel is drawn on the plan 200 feet in breadth at bottom.

Deepening this channel in a straight line to 10 feet of water, at low-water spring tides, would give a depth of 19 feet 8 inches at high-water springs, or 17 feet 1 inch at high-water neap tides. This depth of water can be obtained by an average depth of one foot of cutting in a straight line through the bed of the present navigable channel. I have estimated the quantity of cutting to obtain this depth of water at 48,833 cubic yards, and the expense at 1831*l.* 4*s.* 9*d.* To make the channel 11 feet deep at low-water springs, and 18 feet 1 inch at high-water neap tides, would require an excavation of 131,888 cubic yards, and will cost 4945*l.* 16*s.*

I propose at Ross bay to cut 850 feet long in the direction of the ships' course, 200 feet broad at bottom, and at an average depth of 16 inches; the channel will then be 14 feet deep at low-water springs, as described in the longitudinal and traverse sections, drawing No. 2. The quantity of cutting will be 9444 cubic yards, and the expense 354*l.* 3*s.*

I have calculated the expense of dredging up by engine power at the rate of 4*d.* per cubic yard, including payment to the captain, engineer, fireman, four deck hands, and three dredge punt men, also including the expense of coal, oil, tallow, repairs of boat, engine, working gear, interest on the value of the machinery and steam-boat.

I have estimated the expense of punting the material from the dredge boat to the shore, and discharging the same from the decks of the punts, by shovels on the beach, paying puntmen, labourers, watchmen, including repairs of punts, at 5*d.* per cubic yard, being a total expense of 9*d.* per cubic yard.

I send a small box containing specimens of the material lifted, where the various borings were made; I have numbered them 1 to 10, and I have no doubt but the materials which shall be dredged up will form embankments, if it be properly defended from the action of the sea, by being secured on the surface, and then armed with a stone glacis properly formed and stopped seaward.

It will appear by the plans and sections, that these cuttings in deepening the channel would be very desirable improvements, and could be easily effected from the nature of the bottom strata, the set and velocity of the ebb-stream. I have no doubt but that the proposed cuts will maintain their

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No. 101.

Bald's Report on the Improvements of the Foyle Navigation.

depth without the aid of dykes; indeed any improvement, which would be expected to arise from the erection of dykes, would require the deepest consideration in so open a place as on the flats of Lough Foyle, and I beg it to be distinctly understood, that I have great and serious objections to the embankment of sea lands adjacent to any navigable tidal estuary, river, or harbour; indeed the history of the maritime works of Great Britain announce so many lamentable instances of the destruction of natural navigations and ports by embankments, such, for instance, as the harbours of Rye, Wells Southwold, &c., &c., that those entrusted with the preservation of any navigable river or harbour,, should act with the greatest caution in permitting embankments of any kind being formed, which would have the smallest tendency to shut out any part of the flow of the tidal waters, and on which so much depends; for "who can say what form will cause or will prevent the undermining of banks, the forming of elbows, the pooling of the bed, or the deposition of sands."

In conclusion, I beg leave to state that the navigation of the river Foyle is capable of great improvement, and it would be very desirable that the trustees of the port of Londonderry should have a correct chart exhibiting the depth of water, with all the shoals, banks, and bars throughout the whole length of the tidal navigation from the deep sea to above the city of Londonderry; a document of this kind would be of the greatest value in planning navigable improvements, and which improvements the rising trade of the city of Londonderry now requires.

I shall be very happy to afford any additional information which may be required.

I have, &c.,

WILLIAM BALD,

Engineer of the river Clyde, and the port of the city of Glasgow.

To the Ballast Office Committee, Londonderry.

2 and 3 Wm. IV. chap. 107.

Clause 73.—And whereas it is requisite to secure a sufficient depth of water at the front of the quays, in the said port and harbour, lough, and river of Lough Foyle, and that for such purpose; the river should have a flux and reflux along the quays without being obstructed: be it therefore enacted, That it shall not be lawful for any person or persons to erect, build, or construct any wharf, quay, store-house, wall, building or work of any kind or sort whatsoever, which shall project into the river Foyle, further than or beyond the front line or breast of the present ship quays, now on the side of the said river; and it shall and may be lawful to and for the Ballast Office Committee, or for the mayor and sheriffs of the said city of Londonderry, to remove and abate all such erections, buildings, and works, as encroachments and nuisances, by delivering an order in writing to the respective tenants, occupiers, or owners of any wharf, quay, store-house, wall, building, work, or other erection, setting forth and directing in what manner such encroachment or nuisance shall be respectively altered, set back, removed, or abated; and in case the person to whom such orders shall be directed and delivered shall refuse or neglect to comply with such order, and to alter, set back, remove, or abate, such nuisance or encroachment within the space of twenty-one days after such order as aforesaid, then and in such case it shall and may be lawful for the said Ballast Office Committee to employ workmen, and to alter, set back, remove, or abate every such encroachment or nuisance, and to compel the said tenants, occupiers, or owners, to pay all the charges thereof, by distress and sale of their goods and chattels, to be levied by warrant under the hand and seal of the mayor of the said city of Londonderry for the time being.

No. 102.

Roberts's Report and Estimate for a Pier at Carrickarory on the Coast of Lough Foyle.

No. 102.

MR. S. W. ROBERTS's *Report and Estimate accompanying Plans for a Pier at Carrickarory, on the North-west Coast of Lough Foyle.*

SIR, *Ardee, March*, 1845.

In compliance with your instructions, I have prepared the accompanying design and estimate for a pier at Carrickarory, and which I have now the honour to forward you.

Everybody acquainted with that district of country lying on the north-west side of Lough Foyle, must be aware of the great advantage that would be derived from, and the improvement that would follow, the construction of a pier and harbour at some suitable site on that coast; the present unprosperous state of the fishery loudly calls for some improvement that will afford the numbers of fishermen living on the coast a means of obtaining a better livelihood than they have at present.

I have annexed to this report a return, for which I am indebted to Mr. Anderson, showing the extent and population of the district, which would be benefited by the carrying into execution the measure which I now propose.

One of these evils arising from the want of a harbour or place of shelter on this coast is, that the fishermen are confined to a class of boats, sufficiently small to enable them hauling them upon shore, without difficulty, in rough weather; they are consequently limited to such fishing as is attainable in light and open boats. The great and leading object in forming a harbour on this coast would be, to enable them to keep a larger class of boats, such, for instance, as would be suited for trawling outside the Lough and to obtain in this harbour a sufficient depth of water to enable them to leave or to return to it in any state of tide.

The Derry steam-boats afford a great facility for exporting fish, and have opened good markets for its sale, the result of which has been, as was so clearly given in evidence at the meeting held lately at Derry, by the inspectors of fisheries in Ireland, that the fishermen, not having means of fishing anywhere but in the Lough, have not kept the close season required by law, and this fishery has of course been greatly injured. If a larger class of boats, such as I have referred to, were established, the recurrence of this evil would be to a great extent guarded against, as more extensive and profitable fishing ground would be attainable, and the fish would become as plenty in the Lough as they have been heretofore.

Another advantage that would follow the erection of this pier is, the facility of export and import it would give the surrounding country, which at present, notwithstanding great difficulties, carries on, when the weather will permit, a considerable trade with England and Scotland, of eggs, butter, fish, &c., by means of boats laden on the shore, and rowed out to meet the Derry steamers; if a pier were constructed that would admit of these steam-boats shipping grain, in addition to other market-

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able produce, with facility and without risk, there is every reason to suppose that a very considerable trade would be carried on here.

From Lough Swilly to Lough Foyle, a length of coast about 60 miles, there is no place where either a fishing boat could take shelter in a gale of wind, or a vessel of any kind load or unload a cargo.

The principle market towns in this district are Camdonagh and Moville, situated about 18 miles from Derry, their nearest outport; if a pier were constructed at Carrickarory, its distance from Moville would be only one mile, and that from Camdonagh only 10 miles. This would be a great benefit to this backward but improving country, would have the effect of increasing the value of property, and tend in many ways to develope its resources.

Greencastle pier, situated close to the mouth of the Lough, is of no use whatever; constructed originally in shallow water and in an injudicious manner, it has filled up, and is now dry at low water of neap tides.

This pier was one of those erected by the late Fishery Board, at an expense of 1800*l.*; its inutility may be chiefly attributed to a mountain stream which is allowed to flow into it, and which of course carries into it a large quantity of shingle and alluvial matter, which is there deposited; this harbour might be improved by diverting the course of this stream, so as to admit of its discharging itself to the north of the harbour, a portion of the silt might then be removed, and thus the harbour made available for a small class of boats.

From the inspection I have made of the coast between Culmore and Greencastle, I believe Carrickarory rock to be the best adapted site for the construction of a pier and formation of a harbour. In addition to facilities it affords for the construction of a pier, in water of a suitable depth, is the advantage it possesses of being close to Moville, which is a good market town, and I understand rapidly improving.

On the annexed map is a plan of the site, with soundings marked in feet, and which together with the sections, will give a very correct idea of the locality.

A rock projects from the land, and suddenly dips, affording a depth of water of six feet close to it at low water of ordinary spring tides; from this rock the depth gradually increases to 10 feet, and in this depth it is proposed to terminate the pier.

The rock composing the district is mica slate; great facility exists at Carrickarory for obtaining this stone at a small expense, and I have no doubt but when the quarries are opened, very suitable materials will be obtained for forming the pier.

The winds from which protection is required are those between the east and south-west, and the position of the pier, as I have shown, is adapted to afford this shelter.

For all the purposes for which a pier and harbour are required, there will be ample depth of water, viz, 10 feet at low water spring tides, and 13 feet 1 inch at low water neap tides. This will enable the largest class of fishing boats to take shelter at all state of tides, and will afford steam vessels sufficient depth to be alongside the quay to load or unload.

From the information I obtained from persons well acquainted with the coast, and from my own inspection of this particular locality, I do not think any accumulation is likely to take place in or about the pier; the bottom is hard sand, in some places rock, and the pier being formed in the direction of the ebb tide, and the channel of the Lough being at a considerable distance, the tides will have little tendency to form accumulations in or about the pier.

The great difficulty and consequent expense in constructing piers in deep water is occasioned by the necessity of laying the works under the level of low water spring tides with a diving bell, and the best means of economising this, or using other substitutes in lieu of bell work, has necessarily directed the attention of many engineers to the subject.

The plan I have proposed here is one tried with success on the Shannon at Kilrush, and at Howth harbour. It consists of laying large flags, squared for the purpose, in the manner shown in the section, inclining in the direction of the length pier, at an angle of about 65°; these are set by means of machinery from a stage or boat, and when brought up to the level of low water neap tides, are levelled off and prepared to receive the first course of ashlar work.

The rubble filling is thrown in behind these flags, and when raised to near the level of low water spring tides, the sea pavement there commences and set in the manner I have described in the drawing. A parapet five feet high and five feet thick, with a step two feet wide and 1½ feet deep, should be built, forming the termination of this pavement. The roadway, as far as the turn or elbow of the pier, should be 22 feet wide from the quay to the inside face of the parapet; but from this elbow out to the pier head, I would recommend its width being increased to 40 feet, to give room and facility to steamers to load and unload their cargoes, this being the portion of the pier that would be used by them for that purpose.

Another plan which might be adapted here for that portion of the work under low water spring tides in lieu of the flags, and I think with success, would be to form large blocks of concrete, and to set them in their berths by means of guide piles; should any difficulty be experienced in obtaining flags of suitable lengths, this concrete work might be adopted. The prices in the following estimate will cover the cost of either.

Estimate.

	£.	s.	d.
26,250 cubic feet of squared flags set under level of low water spring tides, at 9*d.*	984	7	6
34,531 cubic feet of rough ashlar work in quay face, including coping, at 6*d.*	863	5	6
15,680 cubic feet of rubble masonry, with heavy thorough coping in parapet, at 4*d.*	261	6	8
3,507 cubic feet of road pavement, formed of rough stone sixteen inches deep, at 2½*d.*	140	13	11
54,000 cubic feet of sea pavement formed of rough flags three feet deep, at 3*d.*	675	0	0
Carried forward	£2,924	13	7

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No. 102.
Roberts's Report and Estimate for a Pier at Carrickarory, on the Coast of Lough Foyle.

	£	s.	d.
Brought forward	2,924	13	7
13,005 cubic yards of rubble filling in hearting of pier, at 1*s.* 6*d.*	975	7	6
44 cubic yards of rubble masonry and parapet walls from pier to roadway, at 7*s.*	15	8	0
Stone steps and landing	30	0	0
Mooring posts, iron rings, &c.	40	0	0
	3,985	9	1
Contingencies and superintending, at 10 per cent.	398	10	11
Total	£4,384	0	0

In the above estimate I have not taken into consideration any land damage occasioned by quarrying, or for other purposes; I have assumed the work to be done in a rough, but permanent, substantial, and workmanlike manner, and I have allowed ample prices for such construction.

I have not allowed the estimate to limit me in the extent of the design. I am of opinion the wants of the locality, the interest of the fishery of Lough Foyle, and the resources of the country, require such accommodation; should, however, difficulty in procuring funds render it necessary to curtail the design, I would recommend its being executed with a view to its future extension.

I have, &c.,
Samuel W. Roberts.

A List of the several Parishes, and number of Townlands, with the Inhabitants, residing within a certain range, that would be benefited by the erection of a Pier, at Carrickarory, nigh Moville, so that shelter and shipping could load and discharge at.

Parish.	Town Lands.	Inhabitants.			Acres.			Remarks.
		Males.	Females.	Total.	A.	R.	P.	
Upper Moville	35	2,517	2,552	5,069	19,081	2	31	Upper Moville.—This parish lies alongside of Lough Foyle, and the greater portion of the inhabitants depend entirely on fishing; they raise a good deal of grain, and their market town is Moville.
Lower Moville	20	2,651	2,770	5,421	15,950	1	21	Lower Moville.—This parish lies along Lough Foyle, and depends almost on fishing; their market town is Moville,
Moville Town	..	284	311	595				
Culdaff	26	2,839	2,911	5,750	20,089	1	20	Culdaff.—A great portion of this parish is inland and raises a great deal of grain; a portion of it is on the sea coast, depending on Moville, and Carn as its market town.
Culdaff Town	..	62	71	133				
Clonca	43	3,229	3,344	6,573	19,613	0	18	Clonca.—This parish lies on the sea coast north-west, depends a good deal on fishing during the summer, and grows a good deal of grain; Cardonagh and Malin are its market towns.
Malin Town	..	96	109	205				
Donagh	15	2,324	2,470	4,794	25,259	0	35	Donagh.—This parish is all inland, with the exception of a small portion on Trawbrigga bay, grows a good deal of grain; Cardonagh, being in the parish, is its market town.
Camdonagh Town	..	319	334	653				
Clonmany	29	3,104	3,192	6,296	23,375	3	30	Clonmany.—Lies on the sea coast and part on Lough Swilly; it raises a great deal of grain; it is cut off from Bumerane by a high ridge of mountains; Cardonagh is the market town for the greatest portion of this parish.
Barryliffen Town	..	92	101	193				
	..	17,517	18,165	35,682	123,369	2	35	

Port Rush.

No. 103.
Rennie's Report on Port Rush Harbour.

No. 103.

PORT RUSH HARBOUR.

Report on Port Rush Harbour, by Sir John Rennie.

Gentlemen,

Port Rush, 5th December, 1829.

I have this day minutely examined the works carrying on for the improvement of Port Rush Harbour; and it gives me great pleasure in being enabled to report, that the progress made since my last visit, in October, 1828, has been extremely great and satisfactory; during last winter every exertion was made to extend the north pier. The quarry was fortunately in good order, and produced the finest materials. The work was continued with unceasing diligence until the present period, when the main body of the pier is advanced 402 feet from the shore, and terminates in a depth of 27 feet at low water of spring tides*. The total quantity of rubble deposited upon it since my last report, amounts to 91,825 tons; which daily becomes more consolidated and approaches towards its ultimate form. About the month of June last, the increasing trade of the port (in consequence of the harbour improvements) required more accommodation. It became desirable, therefore, to erect a temporary wooden landing-place in deeper water: this has accordingly been done; and the largest class of merchant vessels can now load and discharge their cargoes in perfect security, under shelter of the new pier, in 20 feet at low water of spring tides. Towards the middle of June, it became advisable to commence the south pier, as a precaution to prevent the accumulation of sand from that

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* The west pier, on the 10th of May, had advanced to 457 feet; and the depth, at low water of spring tides, was 29 feet.

APPENDIX B.

PORT RUSH.

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quarter: since that period, 8307 tons of rubble have been deposited upon it, which has advanced it 230 feet from the shore, and it now terminates in a depth of eight feet at low water of spring tides, and has had the desired effect of stopping the sand completely: the total quantity of stone, therefore, which has been deposited on both piers, during 13 months, amounts to 100,132 tons. The result of the works, even in their present unfinished state, has exceeded the most sanguine expectations. The harbour is now, in a great measure, well protected against storms from the N. W. (which is the most dangerous quarter), and vessels of the largest class can now lie afloat at all times of tide, without risk or damage: and notwithstanding the severe gales which constantly occurred last winter, and throughout the summer and autumn, which were unusually stormy, the works experienced no injury whatever, from the above-mentioned improvement in the port, so that it is now known throughout the channel as a secure place of refuge for all classes of vessels. A corresponding improvement has taken place in the trade:—for, during the year 1828 (when the north pier had only advanced 190 feet from the shore), the number of vessels that entered the harbour, varying from 10 to 275 tons, amounted to 159; of these, 87 discharged and took in cargoes; and, during the present year, 170 have entered; of these, 126 have discharged and received cargoes: so that it is now no uncommon occurrence to see fourteen or fifteen vessels in the harbour at once; whereas, at no time previous to the harbour improvements, little more than half that number had entered, and the shelter afforded was so trifling, that the harbour was never thought of as a place of refuge, and was only used during fine weather, in summer: and indeed, several instances have occurred of vessels having been wrecked in the harbour. With regard to the funds that have been expended upon the improvements in question up to the present time, it appears that the total amount, without including the Acts of Parliament, which were never comprehended in my estimate, amounts to only 8538*l.*—a sum so small, compared with the great quantity of work performed and advantages obtained, that I know of no similar instance in harbour building; and when it is considered, that the original plan, upon which my estimate was founded, was formed upon the principle of having two piers, the northern only 300 feet long, and terminating in 12 feet at low water, and the southern 280 long, and terminating in eight feet six at low water (whereas the present north pier is even now 402 feet long, and terminates in 27 feet at low water, and the southern pier is 230 feet long, and terminates in eight feet at low water, and only 8538*l.* expended*), I hope it will be allowed that the work has been economically conducted. In fact, when the harbour is completed upon the present plan, there will be none in the United Kingdom, with the exception of Kingston and Plymouth Sounds, which contain so great depth at low water, or have been computed at so small expense: for at Port Rush there will be accommodation for all classes of vessels at low water, from the smallest merchant ship to the largest King's cruizer. With such a prospect, I should humbly conceive that there can be no doubt as to the course to be adopted. The remainder of the present subscription will about complete the piers, in the rough state, with rubble. With regard to the extent of quay room, and finishing that will be required, this you will be able to determine hereafter. I have accordingly prepared a plan, which accompanies this report, showing the harbour is now in progress upon the enlarged scale, with the original design within; from which it will be seen that it will be nearly three times larger than at first intended, and contains more than double the depth of water: and you will, I have no doubt, have no reason to regret your determination of having increased it. The quarries are now improving considerably; and will, I trust, produce as much large stone as will be required. The winter should be occupied in diligently prosecuting the north pier, the last arm, or kant, of which I have directed to be commenced immediately, according to the plan now laid down, until its termination; and I hope that during the ensuing year it may be extended to its full length. The exterior slope, also, of the present works hould be watched and supplied with stone where necessary. The southern pier need not be advanced further at present. Upon these and all other matters connected with the work, I have given Mr. Logan and Mr. Young full instructions, and shall correspond with them constantly during the progress; and it gives me great pleasure in stating, that their endeavours have been unremitting and are entitled to every credit.

I am, &c.,
JOHN RENNIE.

To the Directors of the Port Rush Harbour Company.

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No. 104.

MESSRS. STEVENSON'S *Report on Port Rush Harbour.*

Edinburgh, December, 1844.

AGREEABLY to arrangement with Mr. Taggart, secretary to the Port Rush Harbour Company, Mr. David Stevenson visited Port Rush last month; and during the spring tides of the 23th, 25th, and 26th, carefully inspected the different works connected with it. On that occasion soundings were made throughout the interior of the harbour, and round the ends and seaward sides of the piers; and some bores were put down to ascertain the nature of the bottom near the extremity of the northern pier. As it was not possible, however, on a short visit of inspection, to collect all the information requisite to a full investigation of the subject, farther measurements and borings were ordered to be taken. The results of these observations have since been forwarded to us; and having given the subject all the consideration which our preliminary visit, in conjunction with the information since obtained, enables us to do, we have now to submit the following observations:—

The situation of Port Rush seems well calculated for the establishment of an asylum harbour, both as regards its important position on the coast, and its intimate connection with the neighbouring country. The north-eastern shore of Ireland, extending from Loch Foyle to Loch Larne, is, for the most part, rugged, and is exposed to heavy seas and rapid tides—circumstances unfavourable for the formation of a harbour. The Bay of Port Rush, however, forms a most important exception, as it is entirely protected by the bold rocky natural breakwater, called Ruomore Head, from all winds to the east of north; while the line of coast, trending in a westerly direction to Mallin Head (which is 15 miles further north than Ruomore), forms a considerable shelter from the Atlantic westerly gales; so that it is chiefly in gales from the north-westerly direction that heavy seas occur. It may be stated, as another and chief recommendation to Port Rush, that deep water occurs at a comparatively short distance from the shore; and that the whole of the bay in which the harbour is formed has an unob-

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* The east pier is now 435 feet long, and terminates in 16 feet at low water.

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structed sandy bottom. A safe anchorage is also found off the Skerries Islands, about three miles distant, to which coasting vessels and steamers often resort when overtaken by fog or contrary winds. This anchorage proves a great encouragement and safety to the vessels which frequent the port.

The situation of Port Rush, with reference to the surrounding district of country, is also very favourable, as the present state of its trade abundantly testifies. The River Bann, which enters the sea about seven miles west of the harbour, flows from Loch Neagh for the distance of thirty miles, chiefly through a manufacturing country highly cultivated and populous; and includes, in the immediate vicinity of its course, the considerable towns of Ballymena, Ballymony, and Coleraine.

The navigation of the Bann is dangerous and uncertain, and is little used. There are also considerable physical obstacles to its improvement, both at the "Salmon Leap" (a natural barrier of great extent, which occurs about a mile above Coleraine, and terminates the tideway), and, above all, in the shallow sandy bay into which it discharges itself. Such circumstances are not by any means encouraging; and in absence of further observation, the natural conclusion is, that no very satisfactory improvement could be effected in that navigation, even at a very considerable expense. The harbour of Port Rush, therefore, is at present, and is likely to remain, the only obvious and safe outlet for the produce of this large district of country. The great number of persons who repair to it with their merchandise, to await the arrival of the steamers (of which three called during our short visit of three days), is the most convincing proof that could be sought for of the utility and efficiency of the harbour, and of the favourable light in which the convenience it affords is regarded by the community.

Our attention, however, was not so much directed to the advantages and capabilities of Port Rush, as a situation susceptible of great extension, as to the present state of this harbour, and the safety of the existing works; and we were particularly called upon to consider the most efficient and economical means of rendering them permanently secure. To these points we shall now direct attention.

The harbour is formed by two moles or breakwaters, projected from the high water line, measuring the one 800, and the other 650 feet in length, and leaving an entrance between their extremities of about 200 feet wide. The sheet of water enclosed by these covering piers extends to nearly 8 imperial acres, as measured at low water of spring tides.

With reference to the important subject of a comparison between the present and former depths of water, we have been at some pains to endeavour to discover, from the documents submitted to us, and from personal observations, whether or not any change has taken place in this respect, as this circumstance is one which affects very materially the prospects of the harbour. The chart of 1826, by Messrs. Rennie, who gave the design upon which the works are believed to have been chiefly executed, shows numerous soundings diverging from the old pier head in straight lines throughout the bay. The depth between the pier heads (the positions of which are laid down in dotted lines on that survey) are shown to vary from 15 feet 8 inches to 24 feet; while on the same plan depths of 27 and 29 feet are found outside or beyond the northern pier head, and depths of from 13 to 15 feet outside of the south pier. From the minuteness of its scale, and the want of certain requisite data, it is impossible to lay down on the small survey the exact positions of the existing pier heads, so as to ascertain with which of the lines of sounding alluded to they correspond. Some deviation from the original plan is generally admitted to have occurred in the execution of the work, by which the pier heads were thrown farther south, and consequently into shallower water, than is represented in the plan of 1826. Since the work was stopped, also, the head of the northern pier has been materially altered by the action of the sea, as will be more particularly adverted to hereafter, so as to bring the entrance into still shoaler water. Under these circumstances, therefore, we have found anything like a very accurate comparison between the present and the early depths to be unattainable. It fortunately happens, however, that, for two successive seasons, soundings have been made by Mr. Delap, of Coleraine, in order to ascertain whether or not any silting process, tending to reduce the depth, was going forward. The first set of observations was made on the 15th of June, 1843, and the second in May, 1844, at which time that gentleman reports, that "no material difference was discoverable between the results obtained" on these two occasions. These soundings were submitted to us for verification; and Mr. David Stevenson repeated them on the 24th November last (1844), and after reducing the observations then made to the same datum line for low water of spring tides, which is 10 feet 6 inches below the level of the north-western corner of the stone wharf, no material difference presented itself between the depths then ascertained, and those formerly taken by Mr. Delap. This circumstance is highly satisfactory, and affords encouragement to the directors to expect that the commanding low water depth which they have attained will be preserved. The depth at present between the pier heads varies from 13 feet, at the southern, to 20 feet, at the northern pier, at low water of spring tides; while the same depth is found to exist pretty general throughout the area of the harbour, until the rising beach, extending towards the high water line, causes the water to shoal. The raise of tide is six feet in springs, and four feet in neaps, which, added to the low water soundings of springs or neaps, gives the high water depths at these periods of tide.

The shipping and commercial accommodation that has been provided is pretty extensive. The inner or old harbour, surrounded by a rough quay wall, is occupied chiefly by small craft and fishing boats. From this place, a spacious stone wharf has been built along the face of the northern pier for a distance of 400 feet. This wharf was founded with a diving bell, and has a depth at low water abreast of it, varying from 20 feet at the outer to 15 feet at the inner extremity. A crane has been erected for unloading and shipping goods, and a range of sheds, 100 feet in length, has been provided for the accommodation of traders.

Such is a brief review of these harbour works. The capabilities of Port Rush are indeed very great; and, taking into consideration the depth of water, we are warranted in saying, that an extent and description of accommodation for shipping has been effected, which is rarely to be met with on the shores of the United Kingdom.

We have now, however, to call the attention of the directors to the probable stability of the works, that have been executed,—the subject on which our opinion was specially requested.

The whole of the wharf wall and internal works of the harbour, so far as they go, appear to have been substantially and judiciously built and finished. The covering piers are composed wholly of rubble, generally of large dimensions, and, with a single exception, seem well calculated to answer the proposed end. The exception to which we allude is the extremity of the northern pier, which, while is is undoubtedly the most important part of the work, is, at the same time, that which is the most vulnerable, and the most difficult to secure against injury. This pier lies nearly at right angles to the breach of the heaviest seas that break on Port Rush; and no substantial and suitable termination having, as yet, been executed, the waves have periodically made, and are still rapidly making, inroads

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on its extremity, which, if not checked, must undoubtedly, at not very distant period, prove ruinous to the harbour. Already the mass of rubble, washed by the waves from the outer extremity of the sea slope, and carried round the head of the pier, has formed a projection of not less than from 60 to 70 feet. The level of this projection is now from 2 to 3 feet above low water; and it must, on a moderate calculation, contain about 4000 tons of material. The whole of this great mass of travelled rubble has been carried from the extreme point, and back or seaward slope of the mole, by the force of the sea; and, consequently, extensive inroads have been made on the outermost hundred feet of the pier. The work at that place has been greatly reduced in mass, and its stability has thereby been impaired to a very unsafe extent.

It seems unnecessary to point out the importance of securing this position of the work, as it must be evident that the character of the harbour, as a place of safety for shipping, and the preservation of the southern pier, and the other parts connected with it, depend entirely on the stability of the northern pier. We, therefore, at once pass on to report our opinion as to the most efficient and economical means of rendering these important works permanent and secure.

The spit of travelled rubble which has been moved by the sea extends, as before mentioned, between 60 and 70 feet beyond what was originally intended to have been the termination of the pier. In so far as the purposes of navigation are concerned, the most obvious method of securing and finishing the extremity of the mole would, no doubt, be the erection of a pier head at the extremity of this travelled mass, so as to include the utmost verge of it within the limits of the new work. The borings taken, however, at the extremity of the pier, were found to be entirely through sand for 14 feet below the bottom, or 34 feet below the low water level, beyond which depth the boring could not be carried. The wasting of the mound, also, has now been going on so long unchecked, that the scattered materials have been spread over a large extent; and we are, therefore, quite satisfied that, taking into account these two circumstances, the building of a pier head, such as we refer to, would involve an expenditure of capital very greatly beyond the present views of the company.

Such an expenditure, however, is not necessary; for, after a careful consideration of the various cross sections of the mole, and the other information afforded by our inspection of the works, we are satisfied that a great part, if not the whole, of the materials deposited at the entrance have been washed from the upper slopes of the pier, and that the movement has not extended far below the level of low water. We are, on that account, of opinion, that a work could be executed of a less expensive character than the extended deep water pier head, but which would, nevertheless, prevent further accumulation, and maintain the upper works of the pier at their present height and length; and it is to such a work as this that we recommend the directors, without loss of time, to turn their attention.

In carrying out this plan, we would propose to leave untouched the low point extending from the extremity of the present pier, as a fore shore, or protection for a round head, to be placed close to the abrupt termination of the pier, and to be founded at a sufficiently low level in the rubble composing the fore shore. From the interior of this pier head, we propose to carry a properly constructed glacis around its extremity, and for some distance along the sea slope on the outside or back of the pier. This glacis would require to be founded on a lower level, and to be formed of better materials than that commenced some years since; and in executing certain parts of the foundations, the diving bell must be used. We have considered, in so far as our present knowledge permits, the details of such a work as we propose, and have formed a rough estimate of its probable cost, which, we are of opinion, would not exceed from £4500 to £5000.

From the scattered state of the rubble, and the nature of the foundations, as already explained, we conceive this to be the only really practical mode of terminating the pier consistently with the views and interests of the company; and if executed in a proper and efficient manner, it would completely protect the works from further injury, and prevent the accumulation of rubble at the mouth of the harbour from increasing. It may, perhaps, be stated as an objection, that vessels would be liable to touch on the rubble fore shore in entering or leaving the harbour. But the weight of this objection may even now be tested by past experience, as the spit has for some time occupied its present position; and it is stated that it has not operated as an obstruction to the vessels frequenting the port, the entrance to which is at present of ample width. Should it, however, be considered necessary, a slight spur beacon of malleable iron may be erected on its extremity.

We have only, in conclusion, to urge upon the directors the necessity of losing no time in entering upon these works, if they are approved of, as every storm is undoubtedly rendering their execution more difficult, and their cost more considerable.

ROBERT STEVENSON & SONS.

To the Directors of the Port Rush Harbour Company.

BELFAST.

No. 105.
Evidence taken on the 2nd Oct., 1845.

No. 105.

PORT OF BELFAST.

Examining Commissioner, Capt. WASHINGTON, R.N. and F.R.S.

Present:—A. MULHOLLAND, Esq., Mayor, J. MACNAMARA, Esq., J.P., T. VERNER, Esq., J.P., ROBERT MACOOWELL, Esq., W. PIRRIE, Esq., J. M'NEILE, Esq., R. BOYO, Esq., R. HENDERSON, Esq., CHAS. LANTON, Esq., JOHN FRAZER, Esq., G. SMITH, Esq., W. HAMILTON, Esq., JOHN BATES, Esq., &c. &c.

[*The Admiralty Chart of Belfast Lough and Harbour, by* Capt. BRECHEY, R.N. *and* F.R.S., *in* 1841, *on the scale of six inches to a mile, was laid on the table; also a plan and sections of the Seal Channel, by* G. SMITH, Esq., C.E.]

EDMUND GETTY, Esq., secretary to the Ballast Board, examined.—He was secretary, or, to use an old Irish term of expressing the chief officer, Ballast-master of the Port and Harbour Corporation of Belfast. He had last year transmitted papers to the Secretary of State to the exactness of which he still subscribed. The corporation consisted of 17 members. The parties are nominated at the annual election, but in the event of death, notices are given in the public papers that an election, to supply the vacancy, and when and where, would take place, to which rate-paying parties were summoned to attend. It was a practice perfectly satisfactory to the ship-owners of Belfast; no complaints had been received, which fact he had stated to the Secretary of State; suggestions of improvement had been thrown out, which had been as far as possible attended to by the corporation; there was a *general* complaint that, in consequence of the great increase of shipping to the port, there was a want of

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dock-room, and the deficiency of quay accommodation generally was much felt; the corporation were now making a large quay on the county Down side of the river. He would add, that they did not until recently possess the power of extending the quay; their former Act did not permit their doing so, but an Act passed in 1837 gave them further power. His connexion with the harbour commenced soon after the passing of the Act of 1837, under which late improvements had been made. He begged leave to hand in copies of several memorials to the Treasury and Board of Works, asking for loans of money to improve the harbour, which failed to produce any effect beyond a small loan from the Board of Works; these would show there had been no want of exertion on the part of the corporation. (The following is a summary of the contents of these memorials.)

No. 1, dated 9th June, 1838, and addressed to the Lords of the Treasury, proceeded to show the importance of Belfast to the trade of Ireland; stating that various legislative enactments had been made for its preservation and improvement, viz., 3rd Geo. II., 25th Geo. III. Under these the rise of the port had been so rapid, that, in 1814, the Commissioners of Customs had directed the attention of Government to the question. That several surveys and plans were made by eminent engineers, by order of Government, but none of them were acted on.

That in 1831 an Act was procured by the corporation for carrying out the plan of Messrs. Walker and Burges, and an application was made to the Commissioners of Public Works for a loan of money for the purpose. That after much delay, and a heavy expense incurred by various surveys, made in consequence of the opposition of interested persons, the Board of Works declined lending the sum required.

That in the year 1837 the corporation was compelled to apply for a new Act, the time for the execution of the works under the Act of 1831 having expired, and on this occasion, to meet the views of conflicting parties, they abandoned the plan of Messrs. Walker and Burges, and determined to adopt one proposed by Mr. Cubitt, who had been sent down by the Lords of the Treasury. That the Bill founded on this plan was opposed by Lord Belfast (the present Marquis of Donegal), who had adopted the views of Messrs. Walker and Burges, as originally approved by the corporation. That the new plan was finally abandoned on the recommendation of a joint report of Mr. Walker and Mr. Cubitt himself. [In consequence of this proceeding, the corporation was put to an expense of 6,972*l.* 3*d.* for this Act.] In October, 1837, an application was made to the Board of Works for a loan of 50,000*l.*, which was recommended to the Treasury by them, and contracts were advertised for. That the reply of the Treasury was that they could not sanction the scheme, which they were respectfully requested to re-consider, and to understand that the intended improvements could not, as alleged in a memorial of that body, injure the Ulster Canal Company. The memorial concluded by repeating the injury Belfast would suffer if improvements were delayed, its importance as a commercial town, and by showing that the security offered was undoubted.

No. 2, dated 10th April, 1840, and addressed to the Commissioners of Public Works, after reciting what had been already done, and the various works required, for which a loan of 25,000*l.* had been at length sanctioned, asked the Board to recommend a further grant. The want of quay accommodation was urged, and tables given showing the number of steamers plying, and the great increase of tonnage from 1786 to 1840. It was also urged that Belfast had strong claims on the attention of the Lords of the Treasury, being the first town in respect of trade in Ireland, its imports and exports during the year 1838 having amounted to 8,073,231*l.*, or nearly the fourth of the entire trade of Ireland, and the Customs collected in the year ending the 5th January, 1840, to 341,442*l.* 19*s.* 9*d.* That a benefit would be conferred by this loan on a prosperous part of Ireland, with a population, of which Belfast is the capital and chief commercial port, of 2,293,128, only a fraction less than that of the kingdom of Scotland, by giving it a seaport sufficient for its trade. That the sum now demanded was for the purchase and improvement of the quays. That a deputation of the corporation would present this memorial and give any explanation required.

No. 3, dated July, 1840, and signed by the late Marquis of Donegal, as chairman of the corporation, was a memorial to the Treasury setting forth the necessity of improvements, in consequence of the increase of the shipping, and the impolicy of loading the trade with more than moderate annual sums for the repayment of interest and principal of Government loans. In fine, they asked for 185,000*l.*, to be repaid with interest within 20 years.

This memorial was accompanied by a copy of a letter of the Collector of Customs in favour of the demand made.

No. 4, copy of a report to the corporation, dated 6th June, 1844, recommending certain changes in the charges of the port, and the reductions on quayage which they were enabled to make, having purchased the private interest in the quays. [These reductions, as afterwards stated by Mr. Getty, were equal on the present trade to 7,000*l.* per annum.]

In the course of the examination, Mr. Getty gave the following particulars of the loan made by the Board of Works. It consisted of 25,000*l.* only, on condition that the corporation should, by means of private loan or otherwise, make alternate advances of 5,000*l.* each with the Commissioners of Public Works, the first advance being on the part of this corporation. Of this loan only 15,000*l.* were received; it was clogged with so many conditions, and the law expenses were so heavy, and the difficulty of negociating the long Exchequer bills issued, except at a loss, induced the corporation to repay it in September, 1841, less than two years after the first issue; 5,000*l.* of this repayment being in an Exchequer bill issued to them, but which, in the existing state of the money market, could not be negociated at par. Having failed in procuring funds in any of the numerous modes pointed out by their Act, one excepted, the corporation were compelled to make trial of that one, which had seemed the least promising of any—the raising of money by bonds. It was a proof of the prosperity of this community, that the corporation had found no difficulty in procuring money in that way in their own town to a large amount, as may be seen from the following statement of the bonds issued up till this day:—

£128,320 at 5 per cent.
24,850 at 4 per cent.

£153,170 issued in 405 bonds.

That large sum of money had been expended as follows:—

1st section of Mr. Walker's New Cut	£42,349
Quays purchased	132,798
Light House	1,300
Quays erected or in progress	9,220
	£185,667

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The present income of the port was about 23,000*l.*; 20 years ago it amounted to only 6,200*l.*; 10 years ago to 9,325*l.*; and last year to 25,001*l.* Until 1837 duties on goods were not levied, but their then obtaining an Act of Parliament empowered the corporation to levy such, and also to increase tonnage dues 2*d.* extra, which had continued during the years 1841-2-3-4; tonnage duty was formerly 2*d.*, now 4*d.* per ton. During the last year the corporation had been able to have several dues reduced; pilotage, which was a profit to them had been entirely remitted, the vessels being only charged pilots' wages; tonnage dues on vessels in the Irish coasting trade, which were a low class of shipping, had been reduced from 4*d.* to 2*d.*; ballast also had been reduced from 1*s.* 4*d.* to 10*d.* per ton, and quayage, which rated as high as 7*d.* per ton in some cases, had been reduced to an equal rate of 1½*d.* on all coasters, and 3*d.* on vessels in the foreign trade. These reductions would on the present trade amount to 7,000*l.* per annum. I wish the Commissioner to understand me perfectly. The reductions were not calculated at this amount when made; but were estimated under 5,000*l.*; the increase of trade is such that, were the former rates levied, trade would now pay 7,000*l.* per annum more than it does. The corporation has also been enabled to afford the light on Holywood Bank, free of charge to the trade. During the last 20 years, several sums had been laid out on small improvements, but little compared with that since 1839, when the improvements, which are of real importance to the port, had commenced. He could give the number of vessels, and their tonnage, at this port, at periods of 10 years, from 1786. The following was a true statement of the number of vessels, extent of tonnage, and revenue derived in the

Years.	Vessels.	Tons.	Revenue.
1786	772	34,287	£1,553
1795	801	52,596	2,367
1805	840	69,585	3,728
1815	1,134	91,371	4,169
1825	2,060	183,441	6,200
1835	2,730	290,769	9,325
1845	3,655	445,537	25,001

[Mr. GETTY here handed in a statistical table which he had prepared]. That was a statement for the last 60 years; but during the last year the trade had been relieved to the extent of 7,000*l.* He attributed the increase in the revenue of the port to the prosperous condition of the north of Ireland, as a great manufacturing, agricultural, and commercial community, supported by an enterprising population. In proportion to the increase mentioned, improvements were made by deepening the river, and some quay accommodation given, though it was at the best comparatively trifling; at present there was a great want of this essential; large steamers came up which could not easily obtain berths; the subject was before the corporation; he would, he hoped, explain satisfactorily why they could not sooner accomplish what they desired; the corporation could not agree as to the nature of the improvements to be effected, nor could they obtain an Act, or money to buy out existing interests in the harbour.

COMMISSIONER.—What became of the large sums of money annually accumulating?

Mr. GETTY.—The deepening and dredging of the river was going on; all the difficulties had now disappeared, and the corporation were of opinion that they would succeed in their improvements; they had got possession of property on which improvements could be effected; the property had cost nearly 140,000*l.*; the debt of the corporation was at present 153,170*l.*

The income of the port has averaged an increase of 9,000*l.* a-year. He could only speak since 1837; before that large graving docks were erected, which must have required a large part of the savings of the corporation; the law expenses were considerable; the rest, he supposed, was expended in dredging the river. He could mention the salaries:—Engineer, 500*l.* per annum; Ballast Master, 300*l.*; Deputy Ballast Master, 105; the Clerk, 80*l.* About one-twentieth of the whole income is expended on the management of the harbour.

The COMMISSIONER having referred to the accounts before him, remarked that the law expenses seemed very heavy.

Mr. GETTY.—Several circumstances have arisen to cause the corporation to be before Parliament for the last few years. They required an amended Act to enable them to borrow money; they had to get another amended Act to extend their powers of purchase; can't tell the expense of getting the Act in 1837, as I was not connected with the corporation at that time, but thinks 4 or 5,000*l.*;* thinks that this year the law costs will not be more than 200*l.* In 1844 the law costs must have exceeded 1,000*l.* The law and parliamentary expenses during the last few years exceeded 10,000*l.* in all. I consider that a very large sum; no complaint was made at the Ballast Office; the feeling of the corporation is that it was unavoidable; I think that this heavy outlay has now ceased. Formerly the corporation derived 2,000*l.* a-year from the pilots; the reduction in pilotage has given great satisfaction. The corporation meet once a fortnight, but sometimes once a week; I have known them to meet three or four times in a week when there was business to transact; it is not oftener than once a-year that they cannot obtain a quorum. No member of the corporation receives a salary. There is also a great deal of business done by members on committees, which meet at other times than the days of general meetings. The sums in the accounts before the Commissioner are gross amounts, not net sums, which must be kept in view in estimating the income. The surplus is expended on the harbour; the accounts are audited yearly by Mr. Hertley; they used to be sent to the Audit Office; three members audit the accounts afterwards; the auditor is appointed by the corporation; is sure they would have no objection to have auditors appointed by other persons. The auditor appointed by them is not an officer of the corporation. I wish to give these reports [alluding to the reports mentioned above] to show the efforts that were made by the corporation at various times to raise money, and to prove that there was no disinclination on their part, but that they found great difficulty in raising money. The engineers consulted were Messrs. Rennie, Telford, and Walker. The new cut was principally made out of the income of the port. That is, 32,000*l.* from the income were expended in improving the harbour. I wish the Commissioner to understand the difficulty that we had in procuring money; these reports show the applications that had been made to the Treasury and Board of Works. Even with the income the corporation could show, it was found very difficult to raise the money required; many efforts were made. I accompanied Mr. Harrison, a member of the

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* £6972. 0*s.* 3*d.* is the true sum.

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corporation, when we failed to raise the money in London. We tried the insurance offices and large capitalists; but without effect. Some of them found they were precluded by their charters from making loans in Ireland; other parties refused because it was for an Irish purpose. We raised the money afterwards by issuing bonds among our own townspeople; we paid 5 per cent. for the original loan; we are now borrowing at 4 per cent, and getting as much as we require. Cannot raise as much money at 4 per cent. as would enable us to pay off the original loan at 5 per cent. Thinks the corporation will go on with the improvements as quickly as possible, but on this subject cannot speak authoritatively. I believe there is but one opinion on the part of the merchants and officers of Customs, that the present Custom-house is quite unfit for the business of the port.

Captain GEORGE M'KIMAIN, harbour-master, examined.—Stated that he had been acquainted with the port for 40 years. In 1808, was master of a vessel drawing about 13 feet; was obliged to load at the Whitehouse Roads, which are about five miles below the quays. No steps were then taken to improve the harbour. Not more than two-thirds of the cargo could be taken in at the quays, and when a ship drew from 11 to 11½ feet, she was obliged to be sent down. At that time there were only the coal quay and merchant's quay; there was then a hand dredge for deepening the lough; after the steam dredge it had improved every year; now a vessel drawing 18 feet can come up to Dunbar's dock, but not to the present quays. It would be a great accommodation if such vessels could come to the quays. Thinks that the depth might be increased, but the foundation of the present quays would not allow it. Money would be well laid out in erecting stone quays with a deep foundation, and believes it will be absolutely essential to erect them of stone, if the trade of the port increases in the same proportion for the next few years that it had done for several years past. Traffic has always increased in proportion to the accommodation afforded. On the Clyde and other great rivers, trade had always increased in proportion to the improvements which were made, and the deepening of the rivers. Steam dredging began to be used in this port about 20 years ago; the steam dredge was employed wherever shoals were; the consequence has been an increase in depth of six feet about the centre of the river. There are several slip docks, and the face of the quays, that are a constant expense; they must be cleaned out every second year. There is a great deposit in Dunbar's dock; it is cleaned out by the steam dredge. This dock has now become the property of the corporation; the steam dredge was always employed in cleaning it out even previously to the purchase; the corporation received port dues from it and nothing else. The expense for cleaning it out was from 300*l*. to 400*l*. every year. The corporation formerly dredged out all the private docks; all these are now the property of the corporation. The slip docks in the upper part of the river should be closed up so as to make one line of quay all along; thinks the current of the river would be improved by it; the rate of the current is about two knots. The river goes up to the canal locks, and is there prevented from going higher. Any embankments taken in above the bridge would, I think, prevent the proper scouring of the river.

The COMMISSIONER.—Are you aware that all encroachments on the tide-way below high water mark are illegal?

HARBOUR-MASTER.—I understand so. The new cut I consider one of the greatest improvements which has ever been made in the Port of Belfast, and I think the second cut should be proceeded with also. My opinion as harbour-master has not always been asked with regard to improvements. We would require another dock; believes a tidal one the best for the harbour; sees no occasion for a floating dock; if they could manage to keep the mud away, a floating one might be of great service. Considers that there is not sufficient quay accommodation. I am also pilot-master; there are 30 pilots, 22 branch and 8 supernumeraries; also 16 or 18 out pilots; they are paid by their earnings; they must pass an examination before the corporation; there is a pilot cutter to cruise off the entrance of the lough. No complaints for want of pilots, except in the particular case, when a great number of vessels might be detained at the entrance of the harbour by contrary winds; when the wind changed, there would be such a rush that then a want might be felt. There may have been three hundred vessels at the quay at the same time. They were sometimes obliged, when there were so many in at the same time, to lie two abreast, and the colliers lie end on to the quay. The trade in coals to this port is very large, and it is intended to land the coals at the new quay on the county Down side. The present quays might be extended up to the bridge, and this I think would be of advantage; believes the corporation intends doing so. There is only one sailor in the corporation; one or two are not shipowners; the majority are so; thinks they know enough about shipping to know whether the quays should be increased or not. I have heard no complaints of a want of beacons, buoys, or lights; since the new cut was made, the river has been refitted with buoys and beacons. The light has been altered from white to red; it was at first a floating, now it is a fixed light. The river has been lighted about two years; great complaints were made before this about the want of light. The corporation did not erect one sooner for the reason that they considered the harbour so safe, that a light would be unnecessary. The light has been very useful. We have had a large passenger trade for many years; generally speaking, passenger vessels can come up at all hours.

The corporation has the management of the buoys and beacons at Donaghadee. Has not heard of any complaints before the corporation of dangerous rocks and want of buoys there. Has a large iron buoy placed on Foreland Point; without Foreland Point buoy there is another rock; moved the Foreland buoy about 100 feet farther out two years ago. There are several rocks south of Donaghadee; has no buoy there; has heard of vessels touching on them not sticking on them; thinks it would be hard to keep a buoy on them on account of the rapid tide; a perch would be of advantage. The sound off Donaghadee ought to belong to the Ballast Corporation of Dublin, as it is not in the Port of Belfast. Considers the Black and Orlock Heads to form the harbour. Has heard of the revenue cruizers wanting a second buoy on Carrickfergus bank, but no application has been made to the corporation about it.

There has been a great improvement in the traffic of the port in my time; when I commenced, we had vessels of only 200 tons; we have them now of 700 and one of 875 tons. We can take any of the ships belonging to the port into the present graving docks, except the one of 875 tons. The entrance to the new graving dock is 34½ feet; we can take in steamers by taking off their paddles; the new dock was built about 18 years ago. We have two graving docks; the sill of the new dock is sufficiently low to permit large vessels to enter when discharged.

It would be desirable to have a dock into which vessels could enter with their cargoes; the expense is the only objection to it, as it would be very expensive to pump it out in consequence of the little rise and fall of water at Belfast. I think there should be another dock for timber ships besides

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Dunbar's dock. The Custom-house is a poor old building, very poor indeed when compared with Glasgow, Liverpool, or Dublin. Thinks it would have a most favourable effect to remove the locks two or three miles up the Lagan. Does not consider there will be sufficient accommodation when the quays on the county Down side are finished.

The Custom-house should be in a central position; at present it is at the extreme end. I consider the Lime kiln-dock the best situation for the Custom-house.

Mr. JOHN FRAZER, surveyor for the county of Down, examined.—Has resided in the county Down since 1834; knows the port of Belfast since that time; is acquainted with the Lagan navigation; the depth of water opposite Belfast might be greatly increased. Has heard of the proposed embankment of the western slob; thinks it would be of advantage to the port. A continuous line of sea-wall should be constructed on both sides of the river, as the present quays, on account of their jutting out, are detrimental to the flow of the water; considers a tidal and fresh flow necessary for keeping a depth. My impression is that it would benefit the port by embanking both sides; the channel would be deepened, and a greater body of water brought up to Belfast; at high water thinks there are ten feet over the slobs; can't tell the area of these slobs, but on the Down side there may be about 1000 acres, and 2000 on the Antrim side; thinks it would be advantageous to the port to embank these 3000 acres.

HARBOUR-MASTER.—There is not more than four or five feet over the slobs.

COMMISSIONER.—Suppose we take the average depth of the water over the slobs at six feet, would not 19 millions cubic yards of water be excluded every tide?

Mr. FRAZER.—I do not think this would be injurious to the port, as I would expect the channel to be increased by the scouring power.

I think the river would hardly carry down deposits to lodge at the mouth. Considers there is room for great improvement at Belfast in respect to quays; has no remarks to make on the public buildings; thinks there would be no great gathering of mud at the end of the channel; is of opinion that a dredging machine would keep it open.

The Railways intended to approach Belfast are, the Great County Down—it comes very close to the New Bridge; the Belfast and Holywood—for this there are two bills, one on the atmospheric, and the other on the locomotive. Thinks that the embankments above the New Bridge have been made by purchasing the right from Lord Donegal. Considers that the embankment at Ormeau should be carried down the whole way so as to narrow the channel.

GEORGE MONTGOMERY examined.—I have been a pilot for 15 years; was brought up a pilot; passed an examination; was nine years an assistant in the boat before I got to be a pilot. The traffic in the port has greatly increased in my time. A vessel drawing 16 feet can come up in neap tides, and one drawing 18 feet in spring tides; the Holywood light is a great benefit in the navigation of the river; before it was erected I had frequently to send out a boat to look for the buoys; I complained of this; my complaints were attended to; the light has been up two years; he had been piloting vessels out of the port for 15 years, and for 13 of these had not the benefit of a light. I do not consider that any more lights, buoys, or beacons are necessary; thinks that there are not too many pilots; there is never a want of pilots, except when a great number of vessels come in together, in consequence of the easterly winds. There is not room for the colliers; thinks that Donegal-quay should be kept for steamers. Conceives that the colliers might be put up beside the bridge, or that the quays on the Down side would do very well. There is not a public shed on the quays; public sheds are erected at Glasgow and Liverpool; thinks sheds wanted to preserve perishable articles. A tarpauling had been erected by Mr. Charley for his own private use. The Holywood light can be seen off the Whitehead, a distance of 12 miles; a vessel off Bangor bay can see it. There is good anchorage in the lower part of the lough. Any ship might save herself in a storm with or without anchors or cables; she might run up and take ground in the mud, where she would be secure; that is, provided the wind was blowing into the harbour. Thinks that the second cut over the slobs would be of great advantage, if the Antrim side of the river were embanked; thinks it would not be injurious to the channel. The water that goes into the Seal channel goes out over the slobs. There is a great deal of mud on the flats. There are plenty of mooring rings at the quays, and I have seldom known vessels in a gale to break their moorings. The south-east is the wind most injurious to the quay. There is very little sea at our quays, less even than formerly, since the new quay on the opposite side has begun to be erected. Any vessel might take the lough. I think that if both sides were embanked it would make the water deeper. A large vessel could not turn well in a straight cut. A large ship could not turn in the present straight cut.

Mr. CHARLES LANYON, county surveyor for Antrim, and civil engineer, examined—Has been resident in Belfast for eight years; knows nothing of the depth of water at the port; the tide flows up to the first lock; does not think there is a rise or fall beyond it; knows very little about the river.

The COMMISSIONER remarked that he thought there was a rise of seven or eight feet there.

Examination continued—Does not know on what depends the rise or fall of water at Belfast. Thinks that any embankment above the port would be injurious to it; knows of several embankments above the bridge, and Mr. Thomson's below it, which was made before he came to reside here; thinks its ground area to be about 100 acres; did not know by what right that embankment was formed. The idea of the drainage company was to carry out the second cut to Garmoyle; my opinion is, that it would be beneficial to the harbour of Belfast. The water in the Seal channel rises up and covers the slob; the average depth of water on the Antrim slob is about five feet. I should think the last of the ebb and first of the flow best for scouring; there is a very strong flow of water at the Seal channel. Had examined Captain Beechey's chart attentively; wherever two channels meet the water deepens; still thinks the blocking up the Seal channel would not be detrimental; proposes embanking both sides; thinks that if the Antrim side alone were embanked it would not be prejudicial to the port of Belfast. He considered that the advantages which would result from straightening the channel and embanking both sides would be so great, as to counterbalance any loss of scouring that might take place.

From calculations, he thought that 21,000,000 cubic yards of water would be excluded by the embankment of the Antrim slobs; formed his plan on the Ordnance Survey; did not sound seawards; thinks that the greater portion of the water on this proposed embankment is not useful in keeping the channel clear; believes that there is very little increase of deposit on these slobs; thinks that the action of the tidal flow over them would make no deposit on them. Is not aware that a channel, called the Old North Channel, existed at one time across the flats, in the direction of Mr. Walker's second cut, which channel has filled up. [The ballast-master remarked, that Captain M'Kibbin had sailed through it with his vessel.]

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Captain M'KIBBIN—Formerly there was a channel through this slob; sailed through it myself; it is now completely filled up; is of opinion that there is a great deposit.

Examination continued—Knows nothing of the deposit in the docks of Belfast. Has not perfectly completed the survey of the line of railway to Holywood; had it in contemplation, if the plan of embanking the slob is carried out, to embank both sides. Mr. Rendel has recommended embanking on both sides. An increase in the traffic of the port may be expected from railway communication; has heard great complaints with respect to the want of dock and quay accommodation; thinks it quite inadequate to the growing wants of the town. He believed the Custom-house did not afford sufficient accommodation. Thinks there would be a greater rise of water at Belfast quays, if the embankment was carried out on both sides, and greater equality at the port; the rise could not be above a few inches; the rise of the tide is very unequal at Belfast; attributes it to the obstruction of the tide; a great portion is carried through the Seal channel; from this the slobs are covered; when the slobs are covered, the tide rises more rapidly than before; thinks that the difference of the tide at Donaghadee and Belfast is five minutes. The river should be deepened above the bridge; the piers of the Lagan bridge would not admit of it, but he contemplates its fall soon; as the engineer of the county, he would not of himself, if rebuilding, deepen the piers, but he thought the corporation should look to it. Thinks a large reservoir above the bridge would be beneficial to the port. He would recommend the formation of new quays, docks, &c.; they should borrow the money requisite for the works, rather than want them; as an engineer, he would say, that the quays should be built of stone. He did not think that the navigation at the bottom of the lough would be at all injured by the embankments; a bar would be injurious; does not think there is any chance of a bar accumulating.

Captain JOHN ANDERSON examined—I command a steam-packet sailing between Glasgow and Belfast; I have been acquainted with this port from 20 to 30 years; in my time there has been a great increase in the depth of the river. Thirty years ago London traders were obliged to get their cargoes sent down in lighters to the Whitehouse roads; now vessels with a full cargo, drawing 16 feet water, can come up or leave, though not all times; I think it would be very desirable to increase the depth along the quays; there could be no difficulty in having this effected. I do not think there is any port in Great Britain more susceptible of improvement than that of Belfast. Improvements have been going on for some years, but not so fast as I could wish; thinks the second cut should be made, and more beacons placed; the beacons are too far asunder, so that sometimes I am obliged to steer by the compass; I suggested this to one of the members of the corporation; that suggestion was not attended to. With my vessel I can come up at night, and sometimes at low water, with a heavy cargo. Considers that the second cut would perfect the harbour. I would embank the main channel, and also the whole of the slob, and I do not think it would be prejudicial to the port. Vessels drawing 18 feet water can just swing at Garmoyle; could not afford to loose two feet of water there. Does not think that a slight embankment would intercept two feet of mud there; thinks if the river were embanked that the run of the tide would tend to deepen it, as was the case in the Mersey.

The COMMISSIONER remarked that there was a difference, as the Mersey flowed 15 miles or more above Liverpool, while here it only flows two miles.

Examination continued.—There is but a short flow here, as it is stopped by the Lagan navigation; the Lagan navigation, with respect to trade, is a great benefit to the port of Belfast; I would say that it should be an object with us to preserve it. There is a great want of quay accommodation; it is small in proportion to Glasgow, nor are we, as in Glasgow, under shelter. In consequence of the want of sheds goods are often injured by rain. Sheds could not be erected without widening the quays; the corporation receive a good revenue from the port, and I think part of it should be expended in widening the quays and giving accommodation; I know that the ship-masters and owners wish the quays to be widened. Never complained of the quays; would be thought officious if he did so; has no reason for saying this; never knew the Ballast Office refuse to attend to any suggestion made to them. Thinks that docks also are required; a large wet dock would be necessary; plenty of land might be had for the purpose at a reasonable price. The first cut has been the greatest improvement made in my time; the second cut is very desirable. I never saw a steamer break adrift at Glasgow in bad weather. There are public fenders opposite Mr. Henderson's office. I have not heard of any complaints of ballast having been thrown into the harbour by vessels. Quay accommodation and deepening the river are much required; the deepening could easily be done, either at low water with men and spades, or else with dredges. Remembers when a vessels of 150 tons could not go up to Glasgow; now vessels of 700 or 800 tons can go up to it. Glasgow has derived great benefit from the deepening of the river; I think money could not be better expended than in those things which I have mentioned. There is not a harbour equal to Belfast between this and Cork; I could bring a ship into it at any hour and in any weather, and even if she did run aground, the bottom is so soft that she would receive no injury; she would not even hurt her copper; in this respect I think there is no harbour in Ireland equal to it; I could not do the same at Dublin. In a gale of wind I would run into Belfast lough in preference to Donaghadee. Has not heard any complaints concerning the rocks of Donaghadee; knows the Foreland rock; a buoy has been placed on it by the ballast corporation of Belfast. We want beacons very much, and those so arranged that the one could be seen from the other. I have come up by compass when I could not see the buoys. For want of beacons, I have known vessels to lie to for six or eight hours, and the passengers nearly starved to death. Ship-masters think a floating dock better than lying at the quays; as a ship-owner, I would have no objection to pay for such accommodation.

Mr. M'DOWELL—A pilot has told you that he does not consider any more beacons necessary; does not that satisfy you?

Captain ANDERSON—The pilot is one man and I am another.

To Mr. HENDERSON—Thinks pilots necessary for the harbour; a vessel might not be lost if there were no pilots; knew the "Reindeer" to lie for five days aground. As far as I am myself concerned, I could do without pilots, but I would have no objection to pay them, as I think they should be kept up for those who do not know the port so well as myself. The pilot dues have been lately reduced. I think it necessary to keep up an efficient body of pilots; would rather pay for them than not have them.

Mr. ROBERT HENDERSON examined—I am a steam-packet agent and owner. I have been acquainted with the port and harbour of Belfast for the last 20 years, having been born in the the town.

We are very deficient in quay accommodation. It frequently occurs that we have to work four steamers in one berth, in one day. That is done at great additional expense, labour, and the risk of mixing different cargoes. The quay accommodation is not half what is required for Belfast. Yesterday there were eight steamers at Donegal-quay, and only four berths. The steamers so placed lay with very great risk of damage. This want was particularly felt by steamers, and it was increased by foreign vessels being occasionally brought to Donegal-quay; and these foreign vessels, he was sorry to say, were the property of members of the corporation. They remained a week, ten days, and sometimes a fortnight, whereas steamers often sail on the same day on which they arrive. On Sunday, I had two boats at the quay, and they were obliged to be discharged, loaded, and despatched on Monday. On Monday, we had to land about 1,000 sheep, and ship 220 cattle over another vessel. As regards the corporation, I think private interest should not interfere with the public good. Mr. Charley has sailing vessels, and they always give way for steamers, but those belonging to the members of the corporation never do. It is quite clear we must have greater accommodation. I cannot see why the new quays should be built with timber; I don't think Mr. Lanyon would have sustained his high character, if he had recommended the new bridge to be made with timber. I say, I cannot think how this is, except that there are large timber merchants connected with the corporation.

The next topic which I wish to refer to, is the want of sheds. It must be quite evident that we require sheds very much. At the present moment, I am obliged to keep stores at great expense for the protection of goods coming from the steamers I am agent for. If there were sheds, I would not be put to that expense. A question has been asked about the rate of interest; as a private individual, I can get my bills discounted for 4 per cent., and I don't know why a body like the ballast corporation should pay 5 per cent. I think the difference in the interest would enable the corporation to give all the accommodation required. I agree with Captain Anderson, that there is a deficiency in perches; and, in this respect, the corporation have not acted up to the clause of their own Act relating thereto. The consequence is, that steamers going down the lough, on dark nights, have to place lights at the different beacons, at a great expense. If the corporation complied with the provisions of their own Act, we would not have to do so. [Mr. Henderson here handed in a copy of the Act, and referred to the 153rd clause, which was to the effect, that the corporation was bound to erect and maintain sufficient and conspicuous perches on both sides of the channel.] When I spoke to Mr. Smith about this, and referred him to the Act, he replied that we would soon require a chain from one perch to the other, to take our steamers down the water.

Mr Smith.—I deny that—I never made use of the observation.

Mr. Henderson.—I think I could satisfy Mr. Smith he did; for there were some persons present who heard him as well as I. In getting our vessels berthed, we rarely or ever see any member of the corporation present but the harbour-master. It is his duty to be present; but I would like, also, to see some of the members of the corporation giving us their countenance; and I would not like to see them doing so for nothing—I would like to see them remunerated for their services. I will now come to the pilots. Mr. M'Dowell had inquired if I ever knew vessels suffer damage from coming without a pilot. I can tell him that we have suffered damage from having a pilot. One of them got our vessel ashore; and he admitted it was through ignorance. The machinery of another steamer suffered serious injury, in consequence of the pilot suddenly ordering the engine to be stopped. I lodged a complaint against the pilot, and it was investigated by the corporation. I had all the justice I required; the man admitted the fact, and I did not wish to press the matter against him. I do say that a captain sailing up and down the channel for three or four months could do without a pilot. It is not compulsory in the Clyde to take pilots; even sailing vessels may take them or not, as they please; and I think our own channel as safe as the Clyde. I have had frequently to complain about the position in which anchors of vessels are placed. Our vessels run very great risk of damage in consequence. I complained to both Mr. Getty and Mr. M'Kibbin. I was told there was a defect in their bye-laws with reference to the matter, but that they would have it amended. We nearly got a vessel ruined, which cost 15,000*l.*

In answer to a question, Mr. M'Kibbin said, that a complaint had been made to him with reference to this matter; but he had not mentioned it to the corporation; the cause of the danger arising from the buoy-rope being too long, and there being no bye-law for regulating the length of the buoy-rope.

The Mayor thought a special communication should have been made to the corporation on the subject.

Mr. Henderson.—I had so many complaints to make, that I was delicate in being constantly complaining. I agree with Captain Anderson, that we are deficient in the depth of water generally. It has been said here to-day, that we cannot have a greater depth of water at the quays, with safety to them; but it is outside, where the steamers lie, that we want the depth; for instance, the bank of mud that is there could be removed. All the filth and mud running from Limekiln-dock congregates there. About three weeks ago, one of the boats was delayed two hours by getting on that bank. I spoke to Mr. Getty, and expected that the dredge-vessel would be sent; but it had not made its appearance yet. I am not aware of its being employed in any more important place at the time. I agree with Captain Anderson as to the necessity of the second cut being made, and made as soon as possible.

To Mr. M'Dowell.—I do not think that the formation of the second cut would double the port charges. The corporation had already reduced their dues; and, from the great and rapidly increasing business of the port, I expect a further reduction.

For the four years preceding the formation of the new cut, the income was respectively 10,000*l.*, 10,000*l.*, 11,000*l.*, 11,000*l.*, whereas, in the four years after its formation, it was 18,000*l.*, 17,500*l.*, 21,000*l.* and 25,000*l.* I think the steamers are unfairly taxed in this port. Take, for instance, one of 200 tons' register, and she cannot carry much more than 100 tons dead weight, yet she is charged full dues. I rather think it is the same in Liverpool and Glasgow; but in some ports the case is different. I am aware that, for instance, in Dundalk, the short time the steamers occupy the quay is taken into consideration, and they are, consequently, only charged 3*d.* per ton, whereas sailing vessels are charged 6*d.* per ton. The whole charges in Belfast, including pilotage, amount to about 6½*d.*; and yet the steamers very frequently sail with only half a cargo; one that comes here, not belonging to our company, only carries passengers.

To Mr. M'Dowell.—I don't know that the light-house is absolutely necessary for steamers; I think it is as necessary, if not more so, for sail vessels.

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It frequently happens, that my steamers do not occupy the quay more than four or five hours, and seldom more than 24; and I therefore think that some abatement should be made in the dues to all steamers.

Mr. R. **BOYD** observed, that it was with much surprise that he had heard Mr. Henderson state that the members of the corporation berthed their own vessels, to the prejudice of others. This was charging the members of that body with acting partially, knowing that they had taken a solemn oath to act with impartiality to all. He felt that the allusion was made to himself, and he did not think it ought to have been made. He had been in business for twenty-one years, and had always had his vessels berthed before Donegal quay. He had only been a member of the Ballast Corporation for two years, and his vessels had always been berthed in the one place. There was no order from the corporation not to bring sail vessels to Donegal quay.

Mr. **HENDERSON**—I did not refer to Mr. Boyd particularly; but to my neighbour, Mr. M'Tear, as well. I think some particular place should be set aside for steamers, and leave them without any interference with sail vessels.

Mr. W. **PIRRIE**—I wish to give Mr. Henderson an opportunity to qualify a statement which he made, and which, I think, he did not intend; namely, that the members of the corporation had advantages, as members of that body, which others did not enjoy. I don't think Mr. Henderson wished to convey that.

Mr. **HENDERSON**—I did not wish to refer to any particular individual, when I said that vessels belonging to members of the corporation had priority of berth at Donegal-quay; I only mentioned it as a fact which came under my own observation. For the members of the corporation, individually, I have the highest respect; but I have many complaints to make against them as a body.

Captain **RUSSELL**, harbour-master, examined—Mr. Boyd berths his vessels as near his stores as possible. When he insists on getting his vessel in, it breaks a length; I don't say that that quay is for steamers alone. Coal vessels interfere with the steamers considerably. Mr. Charley, who keeps a coal-yard, has generally three or four colliers at the quay.

To the **MAYOR**—Mr. Charley is not a member of the corporation; but he moves away for steamers, and works over them.

We have not half accommodation at the quay. The sugar vessels could be accommodated at Ritchie's quay, at a slight increase in the cartage of the cargo.

To Mr. **BOYD**—We have berthed steamers at Ritchie's quay, but it is not in order for such vessels. I have never received directions from the corporation to give one person an advantage over another; I have been told to give parties all the accommodation I could. It is very inconvenient for steamers, when those sailing vessels are there.

To Mr. **BOYD**—I have never known you to give way to steamers, when loading your vessels.

To the **COMMISSIONER**—I think it would be an advantage to the town to send the colliers to the county Down side of the river; I think such arrangements should be made as to give the colliers a particular quay, the foreign vessels a particular quay, and the steamers a particular quay. If such arrangements were made, they would be, I consider, of immense advantage; and if Mr. Boyd suffered loss in consequence, by his valuable stores, I think the corporation should remunerate him. It is a long time since the Act for the improvement of the port and harbour was got, and yet the quays are in a more dilapidated state than they were in 10 years ago. The quays, in my opinion, should all be made of stone; and I am certain money could be got at 4 per cent. for that purpose.

Mr. **M'DOWELL** said it would be impossible for the corporation to do anything with these quays till the quays on the county Down side were finished.

Mr. **HENDERSON** thought, if they had made the new quay with stone at once, it would be a great saving in the end; besides, he thought that they had commenced to make it at the wrong end. There was another thing he wished to notice, and that was, that there was no crane on Donegal-quay; nothing of the kind, and there were frequently large quantities of valuable machinery unshipped there, and it had to be tumbled and tossed about, by which great damage frequently occurred.

Mr. **ROBERT M'DOWELL** examined—I am president of the Chamber of Commerce, and a member of the ballast corporation; I have resided a long time in Belfast. On the part of the Chamber of Commerce, I can say nothing with reference to this matter, for they seldom take anything to do with the like; but all the large ship-owners are of opinion, that the present cut is, and will be, perfectly adequate for the accommodation of the town for many years. All we want is quay-room; and I think when the new quay on the county Down side is finished, we will not require further quay-room. As to the making it of timber, I may mention, that we got estimates for the construction of the work, and we found that the interest of the money they would require, in order to build it of stone, would enable them in twenty years to build another; and it was consequently determined to erect it with timber, in order to throw as little burthen as possible on the shipping interest of the port. There is no great difficulty in getting stone here; but we have no granite in the neighbourhood; there is plenty of freestone, but it would not answer our purpose. I believe that timber is some little cheaper here than in many other places. I believe the quays of Waterford and Limerick are built of stone. No other plan than that of constructing the quay at the county Down side was presented to the corporation for increasing the quayage, and they intend to erect sheds and cranes on it. We expect the new quay to be ready in one year. I don't think it was begun at the wrong end. I think the traffic is increasing considerably, and that is attributable to the increased steam communication. As a member of the ballast board, I say, the steamers have got all the accommodation we could give them. I never heard of any complaint being made of want of beacons. We pay attention to every reasonable complaint, and rectify it if possible. Steamers should not, in my opinion, be relieved of pilotage. I never knew of any order being given to any harbour-master to give one vessel a preference over another. I think the making of an embankment from Thomson's-bank to Macedon battery would have the effect of filling up Garmoyle. The ballast corporation I look upon as the conservators of the port. At the time Mr. Thomson reclaimed the slob, we were not as wise as we are now. I believe it was quite illegal for him to do so; I look upon the other encroachments as equally so. I wanted the board to stop them, but the other members did not agree with me in reference to the matter. Mr. Montgomery has reclaimed 50 acres; he has done so illegally, I believe. Mr. Coates has made a small encroachment above the bridge. Any encroachment on the tidal water is injurious to the port. Thinks that any embankment excluding 19,360,000 cubic yards of water would be injurious to the port of Belfast.

To Mr. VERNER—The ballast corporation has reclaimed a large quantity of slob. By doing so, they had to a certain extent, injured the harbour; but it could not be avoided.

[This alludes to the part called Dargan's Island, formed by the stuff thrown out of the new cut; the plan before the Commissioner showed it to be nothing more than the bank of the channel.]

I am not aware whether the Admiralty, or any other body, could prevent the Marquis of Donegal from embanking. Does not think that an embankment from Thomson's bank to Macedon Point would be of advantage to the town.

Mr. W. PIRRIE said an explanation was necessary, with reference to building the new quay with wood instead of stone. The fact was, when the ground was taken from Lord Templemore, the corporation, according to the terms of its agreement, was bound to have it finished within a limited time. They found that they could not spare the necessary funds to complete it all of stone in the time; and if, at the expiration of the term, a part only was finished, the whole would revert into the hands of Lord Templemore at the end of the time—five years. We had not the funds to make it of stone, and we were, in consequence, obliged to build it of timber. I am of opinion, that the embankment from Thomson's-bank to Macedon would not be injurious to the harbour; and, as a reason, I may mention, that I think that there is not a current strong enough to carry any earthy matter down during freshes. It would not carry it far enough—it would settle in the Whitehouse roads. At Liverpool, and other places, the current is strong enough to carry it away: but, suppose it should settle down at the Whitehouse roads, it could be easily taken away with dredges,—and on them we must rely. I think it would be better that the earthy matter, contained in the water, should subside in our channel; for it would be easier to take it away with dredges. There a great want of depth of water opposite the quays, in Belfast. I have been endeavouring to get that matter done for a great many years; and it is the intention of the corporation to do it. I differ with Mr. M'Dowell, that the corporation would not build this side of the quay with stone; for I have no doubt it will be so built. I am of opinion, that pilots should be maintained. I think, in some cases, they might be dispensed with in steamers; but it is necessary to keep up the establishment for the benefit of the trade generally.

Some observations having been made with reference to the dilapidated condition of the Belfast Custom-house,

Mr. M'DOWELL said—I differ with most gentlemen of the town, as to the accommodation in the Custom-house. I have been a merchant in Belfast for upwards of 40 years, and I have always found every accommodation there. If the Government give us a new one, I have no objections; but I would not like the town to be taxed one farthing for it.

Mr. W. PIRRIE.—I may mention that I am strongly in favour of two wet docks, and we have room enough for the purpose. As to a Custom-house, I think we want a new and enlarged one very much. I look upon our present one as a disgrace to the Government, and a disgrace to our town. In every port I know, with less than half the trade of Belfast, they have far superior accommodations. The Post-office and Excise-office are also disgraceful. Looking at the trade of Belfast, I think the Custom-house should be larger, and in a more central situation. We should have more landing-waiters and timber surveyors. I am in favour of sheds and cranes; and I have no doubt but that the corporation will have them erected as soon as the quays have been completed.

Mr. JOHN BATES was then examined, as the representative of the Belfast Town Council. He observed upon the inefficiency of the present Custom-house, and stated, that a memorial from the Town Council had been presented to the Government, praying for the erection of a new one, but the answer received was of an evasive and unsatisfactory kind; in fact, it was looked upon as a put off.

Mr. JOHN MITCHELL, the next witness, was then examined generally, and not in reference to this port alone, respecting screw pile light-houses. His father and he had erected three; one at Fleetwood, one here, and laid the foundations of one on the Maplin Sands, which was afterwards finished by Mr. Walker. Has no doubt they can erect them on any sand bank After some reference to a beacon erected by them on the Margate Sands, and which had been struck by a vesssel in consequence of a signal not being placed on it by the proper authorities,

Mr. MITCHELL explained the failure of the erection on the Kish bank, where the bank itself was carried away. Did not consider the inclining the piles, after they are partly screwed down, as injurious by loosening the sand; the centre pile is perpendicular, and the others lean to it in an inclination of one in five. They had placed above two years ago a centre pile on the Kish, which is standing very well; they expect to finish it next summer. They are also to erect beacons, one on the Arklow bank, and one on the Black Water. Had made an offer to the Trinity House to beacon any of the channels leading to the Thames, or to replace any of the 10 or 12 light ships from the Yarmouth roads to the Goodwins, including the estuaries of the Thames.

Mr. GEORGE SMITH examined —I have been resident engineer at the port of Belfast for 6½ years; the first improvement made in my time was the new cut, by which a depth of 11 feet has been gained at an average low water, which maintains itself without dredging. The next was the new quay on the Down side. The reason I commenced at the lower end was this: even before the corporation had taken any steps for the purchase of the mud banks on the Down side, I had caused the stuff dredged from the river to be deposited along the line of the intended quay, to be used in its formation, commencing at the lower point. At that time Mr. Batt's quay was occupied, and of course no earth could be deposited opposite it. Even after the site was purchased, delays took place which prevented the corporation getting possession of Mr. Batt's quay for a considerable time, and they could not have made any works in front of it; no such difficulty existed lower down.

We intend to carry out Mr. Walker's plan with certain modifications. [Mr. Smith produced the plan showing the modifications.] I propose to form a floating basin opposite the two graving docks. I consider the floating basin would be of great advantage, as it would give one continuous line of quay, and enable the public to go the whole length without interruption, by which the inconvenience now complained of by persons, wishing to go from the quays to Dunbar's Dock, of going round by Corporation and Pilot-streets, would be avoided, additional quay room would be gained, and it might be useful in docking large vessels, as the level of the water could be raised by pumping into it if required.

The corporation propose to fill up the slip docks or two "mud traps," and to continue an uninterrupted line of quay wall.

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No. 105.
Evidence taken on the 2nd Oct., 1845.

I recommend the widening of the quays and placing sheds and cranes on them. There is another argument for carrying out the quays; in consequence of the great width of the river opposite Ritchie's dock and the quays, it fills up with mud. The new quay on the Down side is 50 feet further back than shown on the map.

The corporation have taken a stripe of land for a small dock, but not sufficiently large to effect a complete improvement. They cannot now get a sufficiency of land without an amended Act; thinks they might get an amended Act very easily. Belfast is most conveniently situated on the concave side of the river for scouring; there is no necessity for dredging on the Down side to the same depth as on the Antrim side, if the colliers only are put there. There are several encroachments on the river; the first is Mr. Montgomery's, the second Mr. Coates', on the county Down side, probably about one acre; the third about four or five acres,—["and the fourth," said the Commissioner, "I saw this morning near the first lock of the Canal."] The tidal water flows about two miles up; thinks it of great advantage to the port the further the tidal water can flow above the town. The Lagan naviga- is highly beneficial in bringing goods from Lough Neagh and other places. The Lagan navigation levies tolls on goods. The Ulster Railway takes nearly the same route with the Canal as far as Portadown.

I think it is necessary to encourage every drop of tidal water to the port; knows the scheme of running a line of embankment around the Antrim slob; my opinion is that the channel above it would be deepened, but below it I have a strong opinion that it would be injured. There is also another effect that would take place; 19,000,000 cubic yards of water would be excluded every tide, and if this embankment be made, the whole of this water, which acts as a scour to the Whitehouse roads, will be cut off, and we cannot afford to lose any water in the roads. I conceive the latter part of the ebb and the first of the flood the most favourable for scouring the channel. If the river be embanked below the Seal channel, the velocity of its currents will be increased. I expect a deposit will take place at the entrance and form a bar. I consider that dredging would be very expensive so far down, and we could not work during the easterly winds; the distance is considerable.

Garmoyle is not so necessary as it used to be. I should recommend that the second straight cut be made as far as the Seal channel; that the remainder be left as it is; the remainder of the river is very well sheltered. Between the light-house and Middle-bank there is a neck that might be dredged away.

The deposit of mud in Dunbar's dock is about two feet in the year. I think that if the channel was dredged above the bridge it would be of service. In addition to the sum of 1,120*l*. for building a new quay above the bridge, 5,751*l*. have been expended on new works during the last five years, and the sum of 8,494*l*. in dredging in the last three years; the raising and landing of the soil of the river costs 6*d*. per ton; the mere dredging is about 2*d*. per ton. The steam-dredge is 14-horse power and cost 4,000*l*; was built here, engines and all; she can dredge in 15 feet water; think we shall soon require another; the pier-head at Dunbar's dock forms the line for the projected improvements. I should think it the interest of the corporation to build the quays of stone; wooden walls, when they go, go altogether; I think stone quays the most economical in the end.

The berth of Mr. Henderson's steamers fills up very quickly from the filth that comes out of Limekiln-dock; the steam vessels make themselves a bed by pressing the mud up around them; the dredges are frequently employed in other situations of importance to the trade, when required for Mr. Henderson's berth. Captain M'Kibbin is in error when he supposes the gates of a floating dock or basin cannot be kept clean from having a constant head of water behind them; they can be cleaned by sluicing at low water, which is different from the gates of a graving dock, that have no head of water behind them. The present Custom-house I consider to be a disgrace to the town. From the experience of other ports, and from my knowledge of the increasing traffic of Belfast, I think a sufficient warrant exists for effecting the suggested improvements.—

No. 106.
Rannie, on improving the Harbour.

No. 106.

Report of JOHN RENNIE, Esq., F.R.S., *on the Improvements of the Harbour of Belfast.*

MY LORDS, *London, April 30th*, 1821.

In consequence of Mr. Harrison's letter of the 10th of December, 1819, I directed Mr. John Grantham, a surveyor, to take a survey of the Harbour and Lough of Belfast; which, owing to the severity of the winter and extent of the survey, he was not able to complete until July last: and as I was soon afterwards to go to Ireland, I took the opportunity while there in October to gain as much information about the trade of that place as I could, which, in addition to the examination I myself made in 1815, and the information obtained in January and February last from the Board of Customs of Ireland, and other quarters, has enabled me to submit to your Lordships' consideration the plans that accompany this Report.

The town of Belfast is situated on a bend of the River Lagan, at the place where it discharges itself into the head of an extensive lough or inlet from the Irish Channel. The tide flows up the Laggan for a short distance above the town, but ebbs entirely out of it at low water, leaving only a narrow and crooked channel through the extensive flat sands for the fresh water, which not only in front of the town is very shallow, being from 2 to 4½ feet at low water, but which increases little until it gets to a place called the Flats, a distance of nearly two miles and a half, where it is joined by a channel called the Seal Channel, where at low-water spring tides there is about 8 feet. From this point it gradually increases in depth to 16 feet in a distance of somewhat less than half a mile. And here the roadstead called Garmoyle begins; in which roadstead there is from 18 to 20 feet of water at low water of spring tides. This roadstead is protected from the channel by a point of land that runs out from the south side of the lough, called Hollywood Point. The anchoring ground is good, and the protection such that vessels can ride here in safety in every wind. In this roadstead vessels remain until the tide suits them to work up to the harbour, which, owing to the crookedness of the channel, can only be done with great care, especially if the vessels are of considerable draft of water. As spring-tides rise only 12 feet, and neaps 8 feet, vessels drawing more than 10 feet water cannot navigate safely to the quays in neap tides, nor more than 14 feet water in spring-tides. On this account, therefore, all vessels of a large draft of water are obliged to lighten their cargoes in Garmoyle, and bring a part to the town in lighters. The evils attending such a state of things is easier to be conceived than described; but, to give some idea of the expense attending the trade, I will state for your Lordships' information what I collected on this subject in the year 1815:—

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	£.	s.	d.
The expense attending the ship *Thomas Gelstone*, of 458 tons, in discharging her cargo in Garmoyle, was	208	12	5
The ship *Hugh Crawford*, of 368 tons, for homeward cargo, 75*l*. 0*s*. 6½*d*.; for outward cargo, 66*l*. 8*s*. 9*d*.	141	9	3½
The *Belfast*, from Jamaica, of 256 tons register, incurred in expense of lighterage, officers' diet, &c.	82	0	6
The *Jane*, of 282 tons	39	6	3
The brig *Hugh*, of 232 tons	32	0	0

The above list might be greatly increased, but I presume enough has been adduced to prove to the satisfaction of your Lordships the evil attending such a state of things, as relates to the merchants, in the mere loading and discharging the cargoes of their foreign vessels; but when the losses to merchants from pilferage and damage, and the loss to the revenue from both and from smuggling, are taken into account, the necessity of an improved harbour, by which vessels may get to the quays, and never break bulk of cargo until the goods are to be lodged in the King's warehouse, will be still more apparent.

The shipping in Belfast in the years 1812, 13, and 14, respectively, was, 93,313, 116,591, and 97,853 tons.

The goods and merchandize amounted in 1812 to 1021 cargoes; in 1813, to 1377 cargoes; and in 1814, to 1188 cargoes.

The number of vessels that belonged to Belfast was upwards of 90 sail, of which about 18 measured 150 tons, and no doubt more of them would have been of larger size had they been able to get to the quays; but owing to the shallowness of the water at the town, and the great expenses incurred by shifting a part of the cargoes in Garmoyle, of the smaller classes, and of the entire cargoes of large ships, the trade of this port can never be carried on with advantage while the harbour is in its present state; and the custom-house is situated near the head of the harbour, where the water is the shallowest, and where there is not sufficient room to transact the business with advantage. The buildings, besides, are in an indifferent state of repair and badly arranged. What, therefore, is wanted is,—

First, a sufficient depth of water to carry ships from the deep part of the Lough immediately to the quays, without rendering it necessary to break bulk; and,

Secondly, to place all vessels with foreign or other goods, that pay to the revenue, under the inspection of the King's officers, by which depredations on the goods and merchandize may be saved, and smuggling rendered as small as the nature of the case will admit.

Various situations have been pointed out for docks, and various schemes proposed for their construction. On these I reported to the Right Hon. Robert Peel, in a Report dated 6th of November, 1815, wherein I stated the objections that appeared to these schemes. The surveys that have since been made, and which accompany this, not only confirm what was there said, but render my arguments much stronger, because the depth of water in the harbour and channel, from thence to Garmoyle, turns out to be much less than the statement then delivered to me, and, consequently, renders all the schemes then proposed, except that which has a canal to Garmoyle, ineligible; and in that scheme the estimated expense would fall much short of what it would cost. Objecting, then, to those plans, I will now proceed to state for your Lordships' information the ideas that have occurred to me.

The first and most obvious plan to effect this desirable object is, to convert the whole of the river in front of the town into a wet dock, and from thence to make a ship canal to the deep water in the Lough. This ship canal must terminate either at the buoy of the Flats, at the head of Garmoyle, or near White Abbey, adjoining the town of Carrickfergus, about five English miles from Belfast.

The second plan is to leave the quays and harbour as they now are, and to make a wet dock east of the town, capable of receiving all the vessels with exciseable or customable cargoes, having a canal to communicate with the Lough, either at Garmoyle or White Abbey, and a lock to communicate with the present harbour.

The first plan would give a dock of about 26 English acres of water, 2400 yards length of quay, with ample room for warehouses and transacting the business with facility; but to carry this plan into execution, it would be necessary to make a new channel for the River Laggan across a piece of land on the Downshire side called Ballymacarret, and a canal from thence for the trade of the Laggan into the wet dock. Another canal from the north-east end of the dock to the Lough, either at White Abbey or at Garmoyle, to bring ships from the Lough to the wet dock, would in the first instance also be necessary, because that by this plan the old channel of the river, from the wet dock to the Twining perch, a distance of about half a mile, would entirely choke up; and although the depth of water from Garmoyle by the new cut would improve, it would not improve so much as to render it an object to make a canal from thence namely, the Twining perch, to the wet dock; perhaps, for such a scheme, a canal to White Abbey would be preferable to one to Garmoyle. But an entrance at White Abbey would require a pier to shelter it, because this place is much more exposed to the sea than Garmoyle.

A wet dock of 26 acres would not only accommodate the present trade of Belfast, but one of more than double the extent; but as the trade of this place is said to be more flourishing than any other part of Ireland, there is no doubt that it would increase with the accommodations which by this means would be given to the shipping frequenting it; and therefore it is not improbable that in the course of years the whole might be wanted. The only disadvantage that would attend this plan, would be that vessels containing goods that are to pay duties, and those that are not, would lie in the same dock. This, however, might be remedied by making a division in the dock, opposite High-street, with a communication and swing-bridge, which would separate them, and leave a space of about eight acres for the customable goods, which might be surrounded by a boundary wall, and the custom-house placed where the present one is, having its front within 100 feet of the dock. In this case, however, the canal of communication between the wet dock and the Laggan would have to be moved to the eastern side of Ballymacarret.

That part of the wet dock which extends from High-street to the Bite-perch would be wholly for the use of the general trade of the town, along the front of which there would be a magnificent quay, of about 2100 feet in length, and about 200 feet in breadth. On the opposite side of the dock there might be the dry docks for repairing ships, ship-yards for building, timber, iron, and stone yards, &c. &c. In short, this plan would render Belfast one of the most useful and convenient harbours in the United Kingdom. The expense, however, would be great; and according to my estimate would stand nearly as follows, viz.:

A wet dock	£254,000
A canal from the wet dock to the Lough at White Abbey, with a pier to shelter the entrance	176,280
A new cut for the Laggan at Ballymacarret, with a bridge over the cut	94,800
A canal to communicate with the Laggan	6,600
	£531,680

Exclusive of a new custom-house, stores, and boundary wall round the revenue premises, the amount of which will be stated hereafter.

The second plan is to leave the harbour as it now is, and to construct a wet dock on the reclaimed land north of the town, being in part the property of the Corporation of Belfast; in part, Mr. John Ritchie, Messrs. Wharton, and others. This wet dock is proposed to be 1220 feet long by 360 feet wide, which will cover about 10 English acres with water. It is proposed to communicate with the present harbour by a short cut across Mr. John Ritchie's and a very small piece of the Corporation property, having a lock at the junction. This piece, however, is so small, that it would not interfere with their plans for a

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new dock, which is now constructing there. From the eastern angle of this wet dock a canal may be made to White Abbey; but upon this reduced scale, perhaps, it would be sufficient to carry a canal to Garmoyle. By this plan a dock would be obtained which would be totally separated from the home trade by being enclosed by a boundary wall, the whole business would be under the inspection and control of the revenue officers, and it would have a connection by means of the lock by the Corporation grounds with the present harbour, and by the canal with the deep water in the Lough. The amount of this scheme, according to my estimate, would stand as under, viz.:—

A wet dock, including the purchase of the necessary property and boundary wall	£111,000
An entrance lock and cut from the present harbour to the wet dock . .	53,800
A canal from the wet dock to Garmoyle	94,650
	£259,450

This estimate, like the former, is exclusive of a new custom-house, stores, and boundary wall, the amount of which will depend on the extent of stores required, which for the present trade would not be very considerable. In the plan, however, I have laid down a sufficient extent for every thing that can be wanted, by supposing the boundary wall to be placed at the distance of 250 feet from the side of the dock, which will allow ample room for a range of warehouses on each side, if wanted, and for quays and carriage road between the back of the warehouses and boundary wall. Thus there would be contained within the wall 44 English acres, which is quite sufficient to admit of a very considerable increase of trade to what there is now at Belfast. . . .

The scheme of a dock on the reclaimed ground east of the town, including a canal to the head of Garmoyle, is stated in the estimate 259,450*l.*; if to this is added the amount of two stores, 70,000*l.*, and say for a custom-house 20,000*l.*, the whole expense would amount to 349,450*l.* But if, in the first instance, the dock and entrance into the harbour, with a custom-house and two store-houses, only were to be made, and the canal to the head of Garmoyle be suspended until a future period, the whole expense would only in this case be 254,800*l.*

In the scheme of making a dock on the reclaimed ground east of the town, I have not laid down a Corporation dock; but if one is wanted at any future period, there is space enough reserved for that purpose between the dock I have laid down and the tide-way on the east side, and it may communicate with the harbour by the same entrance-lock as the custom-house dock, and by the ship canal with Garmoyle; or the custom-house dock may be laid at right angles to York-street, and a Corporation dock constructed parallel thereto. These points can, however, be better decided in conjunction with the officers of the revenue and the merchants at Belfast, should your Lordships adopt this plan, than they can at present. But if ever it shall be decided to be done on this plan, in preference to what I have laid down, there will be little or no difference in the amount of the estimates I have given.

I am, &c.,
JOHN RENNIE.

To the Right Honourable the Lords Commissioners
of His Majesty's Treasury.

No. 107.

Rennie, on improving the Harbour.

No. 107.

Report of JOHN RENNIE, *Esq., F.R.S., on the Improvement of the Harbour of Belfast.*

GENTLEMEN,

London, 30*th August*, 1826.

In consequence of your Resolution of the 25th of November, 1824, requesting my opinion in the fullest manner possible, as to the most proper plan that should be adopted for the improvement of the port of Belfast, and in so doing, if possible, to avoid imposing any increased dues upon the shipping, I examined the port and haven in the month of October last, but finding that the documents relating to the subject in my possession were not sufficient to enable me to form a correct opinion, I was necessarily compelled to obtain additional surveys and information, which on account of the late period of the season could not be commenced before the spring of the present year, and have only lately been completed.

Moreover, having been requested by the Committee appointed by the counties of Down and Antrim to give them a plan for a new bridge across the Lagan, I was anxious, if possible, to combine the two schemes together, inasmuch as they are materially connected with each other. Finding, however, that a design for a bridge over the Lagan in its present state was desired, I reported upon it separately in March last, and now beg leave to offer my opinion upon the improvement of the harbour, although it would certainly be the interest of both that they should be connected.

The improvement of the port of Belfast is a subject of the greatest importance, not only as regards its own prosperity, but that of the whole of the flourishing and extensive district of the North of Ireland by which it is surrounded.

The numerous shipping (amounting to near 200,000 tons, and which are daily increasing) are subject to so much inconvenience, delay, and extra expense in frequenting the port in its present state, that some remedy is imperiously called for; and those defects, which in the infancy of trade might be tolerated, can no longer be patiently endured—where dispatch and economy are now become absolutely indispensable, from the increased competition and activity which prevails throughout the whole commercial world.

It fortunately, however, happens that notwithstanding the existing defects, Nature has already done much, and by the assistance of Art this part may be made one of the most complete in the United Kingdom. The subject, as may be naturally supposed, is not altogether new, but attracted the attention of the late Mr. Rennie, in the year 1815; and towards the latter end of 1819 he was directed by the Lords Commissioners of his Majesty's Treasury to investigate the whole, and prepare a plan for the improvement of the port, and for the better security and collection of the revenue. Mr. Rennie accordingly employed Mr. Grantham to survey the harbour and the Lough of Belfast, and on the 30th April, 1821, Mr. Rennie delivered in his Report and Plans to the Treasury, wherein the whole subject was more fully discussed. The plans consisted of two; the one to make a new cut for the Lagan, and to convert the whole of the old channel in front of the town into a wet basin, communicating with a lock canal to the roadstead of Garmoyle or White Abbey. The other to make a separate basin for the revenue, in the reclaimed ground near the new dry dock, communicating with a lock canal to the roadstead of Garmoyle or White Abbey. The project for making a ship canal along the north side of the Lough to deep water towards White Abbey, although explained generally, was not completely matured.

The defects of the present port have been already stated by the late Mr. Rennie, and are amply borne out by the survey of Mr. Grantham, and have been subsequently confirmed by my own experience; it will not therefore be necessary to enlarge much upon them. From these surveys it appears that the present town of Belfast is situated on the north side of the river Lagan, where it discharges itself into an extensive lough or inlet from the sea, and the tide flows up the river a little above the town, but ebbs out nearly at low water, so that the channel becomes almost dry, except where an insignificant stream pursues its course in a meandering direction towards the safe and commodious roadstead of Garmoyle, situated about two miles below the town, where there is about sixteen feet at low water. Spring tides seldom rise above twelve feet at the town quays, and neaps about eight feet, so that almost all classes of vessels

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frequenting the town, in the first instance, are compelled to bring to, and anchor in Garmoyle Roads, unless at the time of their arrival there is sufficient water and flood current to carry them through the intricate and difficult channel of the Lagan, up to the town; and consequently all the largest class of vessels, drawing above eight feet, cannot get there during neaps, and those drawing above twelve feet cannot go at all, and are necessarily compelled to lighten their cargoes in the first instance, at a considerable expense; when, after having discharged their cargoes, from the above causes, they can only take in part of their fresh or export cargo, and are obliged to complete their loading at Garmoyle with lighters, and after all they may be liable to be neaped and remain a fortnight or month before they can go to sea. The expense of such a mode of proceeding may be readily conceived, independent of the great inconvenience, loss of time, risk; which evils in themselves are, if possible, of greater importance, for it not unfrequently happens that by losing the advantage of a favourable wind and tide to go to sea, the prospects of a voyage are ruined. As examples of the above, it will be only necessary among many others to recite the cases of the *Thomas Gelstone*, 458 tons, the *Hugh Crawford*, 368 tons, the *Belfast*, 256 tons, the *Jane*, 282 tons, and the *Hugh*, 232 tons, whose united cargoes, amounting to 1596 tons, cost 503*l.* 8*s.*, or 6*s.* 3*d.* per ton upon the average before their arrival at the quays—a charge which so far exceeds those of any other port, and is in itself so enormous, that except at a flourishing place like Belfast, where cargoes can be obtained and disposed of so readily, would almost amount to a total exclusion. As an example of delay, it will be only necessary to quote the case of the *Collier*, commanded by Captain Hewit, 84 tons burthen, and one of the handiest in the trade. From his statement it appears that he loses upon the average four days every voyage, in consequence of the bad state of the port; so that one-third of his whole time, including expenses amounting to 20*s.* per day, is lost. This upon so small a vessel is a serious charge, and from this the expenses incurred by the larger vessels may be readily conceived. Notwithstanding all these obstacles, which certainly are of no ordinary nature, the trade and shipping of this port have increased to an immense extent, until now, when it is justly termed the second port in Ireland.

By referring to the following Table, collected from official documents, it will be seen that the trade and shipping has increased nearly four-fold during the last forty years, and as it still continues to increase in an extraordinary ratio, by proper care and management, and by removing the difficulties which now exist, it is difficult to foresee where its prosperity will terminate:—

	No. of Vessels.	Regular Tonnage.		No. of Vessels.	Regular Tonnage.
In the year	1786—761	38,421	In the year	1810—1105	95,211
	1790—806	48,131		1815—1134	91,471
	1795—869	52,234		1820—1477	127,335
	1800—856	67,855		1822—1735	153,500
	1805—894	69,582		1824—2040	175,294

Having described at length the defective state of the present harbour of Belfast, and having pointed out the necessity and advantage that would result by the improvements thereof, it only remains to consider maturely a plan which, under all the circumstances of the case, shall be best adapted to obviate the evils complained of. The principal defect, as already observed, is the want of water; so that vessels of the largest class may come up to the town at all times of tide, and depart at once whenever they have completed their cargoes. This most important object may be obtained in three ways: first, by making an open tide canal to Garmoyle, and converting the old river in front of the town into a wet basin, or making a basin independent of the old river, on the reclaimed ground adjoining the corporation dry dock, or near the old channel, as described on the plan: second, by making a lock canal to Garmoyle, having a basin, as before, and entrance into the old river: third, by constructing a basin, as above described, and making from thence a navigable ship canal, with an asylum harbour, at the entrance near Silver Stream, which is about five miles below the town.

With regard to the first plan, it may be observed that such a canal might be made, in the first instance, capable of bringing up large vessels, and by having a lock at the entrance into the basin, they might always be kept afloat, and be enabled to depart to sea when necessary. The expense of this scheme would amount to 131,674*l.*, but the difficulty of keeping such a channel open for any length of time would be very great without an *enormous expense* of dredging, and after all it would scarcely be kept navigable at all times of tide for the largest vessels.

The harbour of Venice, where they have no alternative, is maintained in this manner, but the expense is perpetual, and every now and then by the prevalence of particular winds, is blocked up altogether. It does not, therefore, appear to me a permanent scheme, or such as would in the end be likely to answer the purpose intended.

With regard to the second, by having a lock at the entrance of the above canal into Garmoyle Roads, the navigation would be more certain and more easily kept open. Vessels would arrive and depart at all times of tide, and proceed to sea whenever ready to do so.

It might perhaps, however remote, be urged against this plan, namely, that the canal in question, by having its banks for such a distance beyond the shore above high water (without which it could not be effectual) might operate as a great jetty, and by interfering with the circulation of the ebbing and flowing tide, which covers the immense mud banks at the upper end of the lough, might in process of time accelerate the deposit of mud, so that ultimately the whole would be raised above high water, and by thus diminishing the quantity of back water, would affect the depth of water in the roads of Garmoyle, and render its extension further into deep water necessary; such an effect, however, is uncertain, and would necessarily be remote.

The expense of this plan, in the first instance, would be proportionably, on account of the difficulty, risk, and uncertainty of executing the work in the tideway, and could not well be estimated at less than 134,660*l.*, including the basin; although, therefore, upon the whole, it would be better than the first plan, nevertheless it would not be so complete as it should be.

With regard to the third.—By making a navigable ship canal from the basin near the town along the shore of the lough about high water mark, as far as a place called Silver Stream, about five miles from the town, and by there constructing an entrance harbour, provided with proper locks and sluices, at such a depth that vessels might enter at low water, as more particularly described on the accompanying plan, the evils above stated would be obviated at once, and the largest ships would come direct from the sea at all times, and pass into the canal, and be carried up to the town without breaking bulk until their arrival, which would be about one hour and a half after coming from sea. In the same manner they would receive their cargoes at the town and proceed to sea without further inconvenience. The speed moreover might be accelerated by locomotive or steam-engines, or railways if required.

This canal would pass through the whole of the extensive and daily increasing manufacturing district along the north shore of the lough, which would by this means obtain a ready communication with the town for the disposal of their goods, and for receiving their raw materials; and would, consequently, I should conceive, be willing to pay for wharfage and transits, which would form a considerable article of revenue. By this plan, no interference would be made with the present harbour, and consequently the risk and uncertainty of working upon these extensive mud banks would be avoided.

The difficulty and delay also of working into and out of the present roads at Garmoyle (which, on account of the bank situated between Garmoyle and the sea, upon which there is only nine to ten feet at low water, is at times extremely troublesome) would be avoided.

The execution of the above project would be by no means difficult compared with its magnitude, inasmuch as the line through which the canal would have to pass consists chiefly of sound earth and fine sandstone, which would stand as moderate slopes, and the stone might answer for the quays and locks.

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There is also plenty of fine limestone rock, situated about three miles from the shore, which would readily be brought down by railways, for the purpose of forming the entrance harbour. These are certainly great advantages, and would be the means of making an important saving.

The estimate for making the canal, entrance harbour, and landing basin at Belfast amounts to the sum of 269,546*l.*, and considering its extent, magnitude, and importance, I know of no port where such great advantages would be derived from it.

It will be observed that there are two other lines marked on the plan for the canal; one of which is made to avoid a bend along the shore. This, however, could be adopted or not as circumstances might hereafter render advisable, and the lines of the piers might also be improved when carried into effect.

The plan of the late Mr. Rennie for converting the whole of the present old channel in front of the town into a wet basin, and of diverting the channel of the Laggan through Ballymacarret, would no doubt form a most valuable addition to the canal and entrance harbour; as by that means no new warehouses would be required, and every proprietor would be enabled to bring his own vessel up to his own wharf without further inconvenience. The landing basin at the head of the canal might also be dispensed with, and further, as it is in contemplation of the counties of Down and Antrim to construct a new bridge across the river Lagan, they could not do better than to construct it across the new channel; and this, together with the new channel itself, might be done for nearly the same money as it would require to construct a new bridge across the old river, immediately above the present bridge.

Upon the whole, therefore, viewing this most important subject in all its branches, I think that the plan of making a canal to near Silver Stream, with an entrance harbour and basin, adjoining the town, will be found the most economical and effective measure to be adopted; and with regard to converting the old river into a basin, and making a new channel for the Lagan this can be deferred for the present, unless the counties of Down and Antrim are anxious for a new bridge *immediately*, in which case they might contribute by making the new channel and bridge over it.

The formation of the basin might be done at a very moderate expense, as it would be merely necessary to dam up the water in front of the town by a simple bank, without quay walls, leaving the present old quays as they are now. In that case the basin and lock adjoining the Corporation dock, and included in the estimate, might be dispensed with, and the aggregate estimate would not be much augmented. By this means the great object of constant deep water in front of the town, and ready access for ships to and from sea at all times, would be obtained, and any minor improvement could be made hereafter, if necessary.

With regard to the ways and means of defraying the expense of carrying the plans above recommended into effect, I should not however apprehend much difficulty (although I fear that they could not be obtained without some small additional charge), when the subject comes fairly under discussion, and when the present enormous expenses, and inconveniences, and delays, to which ships are subject, are compared with the almost inevitable advantage and economy that would be derived from the plan above described.

By referring to the revenue and harbour dues actually received, it appears that they amount to the sum of 6254*l.* per annum; and after deducting the attendant expenses, viz., 4644*l.*, there is a clear revenue of 1610*l.* But in the event of the above work being carried into effect, the pilotage, lighterage, and buoys dues at Garmoyle would be saved, so that the clear revenue, according to the present charges, would be 4714*l.*, leaving the remainder for superintending the new works; and if to this were added a tonnage duty of 1*s.* per ton on all vessels coming to the town for a certain number of years, the amount derived upon 175,294 tons delivered, and from the same carried away, would amount to 22,243*l.* per annum, which, by being properly applied, would in a short time liquidate the whole expense incurred, and render the port free, and with advantages surpassed by none; besides making an annual saving to the trade of all their present private expenses. The precise amount of these I am ignorant of, but they must amount to an enormous sum; and merely taking these charges, as above stated, at 6*s.* 3*d.* per ton (and in many cases I believe they are much more), and only calculating this charge upon half the homeward and outward bound trade, or upon 175,294 tons for the whole, it amounts to the immense sum of 52,588*l.* per annum; and deducting 17,529*l.*, the expense of 1*s.* per ton for the new works, there would according to this be a clear annual saving to the merchants of 35,059*l.* per annum, besides the inconvenience and loss of time, which to every merchant must be incalculable. I have merely thrown out the idea of 1*s.* per ton, on aggregate, by way of showing a return for the capital to be expended. This, however, might be regulated and apportioned according to size of the vessel, her draught of water, and other contingent circumstances; and, considering the object obtained, few merchants probably would be unwilling to pay it.

With a prospect, and almost certainty, of such advantages, at comparatively so small an expenditure I should think that there would be no difficulty in obtaining funds. Belfast would then acquire advantages possessed by scarcely any port in the United Kingdoms, while its dues would be far less than those of London, Liverpool, Bristol, and Leith; and under such circumstances its prosperity would necessarily continue to increase, without fear of rivalry from any other. The saving to the revenue also by the above plan would be immense, and might be an object for the favourable consideration of Government.

I am, &c.,
JOHN RENNIE.

No. 108.

Telford, on the Port and Harbour.

No. 108.

Report of THOMAS TELFORD, Esq., *respecting the Port and Harbour of Belfast.*

London, 14*th Nov.*, 1829.

THE present very defective state of Belfast Harbour, and its evident unfitness for the due accommodation of the increasing trade of an active and industrious town being sufficiently admitted, all persons concerned in commercial transactions at this port must be sensible how much it is behind others of less importance, although possessing capabilities much surpassing them; I shall therefore proceed briefly to state,—

That having examined the present quays and the channel of the river Lagan, from thence to Garmoyle, also that excellent roadstead and its connexion with the estuary beyond it, and likewise the localities in the vicinity of Belfast, I have, after duly weighing all the circumstances of the case, formed a plan which appears to me to embrace all the requisites for this port.

By inspecting the plan above referred to, it will be seen that I propose commencing a canal at the skirts of the mudbanks near Garmoyle, and there to construct a couple of tide-locks, each 48 feet in width, capable of admitting trading vessels and steam-boats of large dimensions. The sills of these locks are intended to be laid about 12 feet under the level of low-water, which will admit vessels drawing 20 feet water to enter and depart at neap-tides. From these locks up to the entrance of the eastern dock the canal will be kept up to the level of the top water of spring-tides.

From thence along the southern side of the town the space is occupied by three floating docks. The first or eastern dock is about 680 yards in length; the middle one is about 250 yards; and the upper or western dock is 450 yards in length. Between the docks there are regulating lock-gates and double swing bridges. These three docks are intended to be excavated to the same depth as the canal.

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By adopting this plan, it is necessary to change the direction of the river Lagan, as shown upon the plan, making a regular weir and a set of draw-sluices, so as to keep up the surface to the level of high-water of a spring-tide, and having the power, by means of the sluices, to draw it down when necessary.

This new river channel, by joining a straight reach of the old river, will operate more effectually towards keeping it open than what it obtained by the present circuitous course. By this means small coasting vessels may pass up it and discharge and load at quays adjacent to the eastern extremity of the eastern dock without entering the canal or docks.

By this arrangement the two principal docks are placed opposite to the busy parts of the town, and are of such dimensions as to accommodate an extensive trade, while the upper or western dock is well calculated—

1st.—For timber yards, also for building and repairing vessels.

2ndly.—For laying up vessels during the winter months.

3rdly.—To operate as a conductor for the river water for supplying the docks, and for lockage, without lowering the surface of the water in them or in the canal; and

4thly.—As forming a convenient communication with the Lagan navigation, and, through it, with the adjacent country.

By inspecting the plan, it will be evident that the roads between the counties of Antrim and Down will be sufficiently commodious either as regards markets or for commercial purposes.

With regard to providing that the present common sewers of the town of Belfast shall rather be improved than injured by the harbour operations, I propose that one general and capacious sewer shall be constructed to receive all those of smaller dimensions. One portion of this to be carried eastward and discharged into the back drain of the canal; and the other westward, along the mound at the upper end of the western dock, and thence along Ballymacarret to that part of the old river-channel which is to be kept open.

To perform the works here specified, I estimate the expense as follows:—

	£.	s.	d.
Entrance, Locks, and Canal.—Constructing two tide-locks, with platforms, gates, machinery, capstans, mooring buoys, mooring posts; also excavating and forming canal, and securing its outside and inside slopes with rubble stone	121,453	17	8
Docks, &c.—Excavating and constructing the east, middle, and western docks, with their wharf walls and defenders, mooring-buoys and rings; also constructing coffer-dams for putting in wharf walls on the north or town side, engines for pumping water at various places, and making a tide-basin for small coasting vessels, with wharfs	136,160	15	4
Constructing interior locks and swivel-bridges, with capstans, &c.; forming new river course, with waste weir and draw-sluices, building two stone bridges across ditto, embanking west end of upper deck; forming a channel for river water; constructing a barge-lock, with various roads of approach	91,059	10	0
Sundry Works.—Constructing cranes on sundry parts of the wharfs, also sheds on north or town sides, lock-keepers, houses at tide locks, paving wharfs, and making a large common sewer	18,881	0	0
Surveys, plans, act of parliament, superintendence, management, and incidental expenses, 10 per cent.	36,755	0	0
	£404,310	3	0

THOMAS TELFORD.

No. 109.
Rennie, on the Improvement of the Port.

No. 109.

Report by JOHN RENNIE, Esq., *on the improvement of the Port of Belfast.*

GENTLEMEN,

Belfast, December 10*th*, 1829.

In consequence of your resolution of the 3rd inst. (which was communicated to me by Messrs. Batt, McDowal, and Grimshaw), wherein you request to have my opinion again upon the best mode of improving this port, keeping in view in the formation of the place such a prudent scale of expenditure as will obtain the most important objects at present, united with the power of extending it hereafter, according to the increasing wants of the trade, I have done so accordingly, and beg to observe as follows:—Having fully given my opinion already upon the present inconveniences of the port in my Report of August, 1826, and the subject having become so notorious, it would be needless to enlarge further upon it here.

The first object to be obtained is deeper water, in order to bring vessels up to the town; and when there, to accommodate them in floating docks, having proper quays and every other requisite for loading and unloading their cargoes.

To obtain this, I recommend, as formerly proposed by the late Mr. Rennie and myself, that a canal should be made from near Garmoyle, having locks 48 feet wide, laid at such a depth (12 feet below water), which would always give 20 feet at high water neap tides, and would enable the largest vessels to come up to the town. This canal, completed in a proper manner and paved with rubble, would cost 102,815*l*. At the termination of the canal I recommend a large floating dock, 1600 feet long and 500 feet wide, surrounded with quay walls having the same depth of water. This dock would contain about 18 acres, and would give 4000 feet of additional quay-room, and would accommodate about 100 vessels of large tonnage, and would cost 83,327*l*., making a total sum, including the canal, of 186,142*l*. These two important works once executed, the greatest of the present difficulties would be overcome, and they might be carried into effect without interfering in the least degree with the present trade and accommodation of the port; the tonnage dues to defray the expense would be comparatively light. The further wants of the trade might then develop themselves more correctly; and additional accommodation might be carried upwards as required—the very heavy expense of purchasing the quays in the first instance would be avoided—and during the progress of the works upwards the trade would be accommodated, which in every point of view is of the greatest importance. If, however, notwithstanding the great advantages, it should be found preferable to construct a dock in front of the town quays in the first instance, the middle dock, 1800 feet long and 500 feet wide, as laid down upon the accompanying plan, might be carried into effect. The construction of this dock would necessarily involve the purchase of the Donegal quays and adjoining buildings at a heavy additional expense besides the dock and canal, which I estimate at 212,119*l*., and would take away the use of the present Corporation Graving Docks, although the trade might still be carried on from thence to the Long Bridge, and by giving accommodation elsewhere, the same quantity of quay-room might be preserved. If after the completion of this dock more accommodation should be required, the third dock might then be commenced, and in the mean time the trade could be carried on without interruption in the other docks. The third dock would be 1200 feet long and 600 feet wide; and, including a new sewer, would cost 66,536*l*., and the additional expense of purchasing the quays adjoining. The whole length of quay-room that would be afforded by the three docks

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would be 11,600 feet, which is 7600 more than the present, and would accommodate about 270 vessels of the largest class at one time.

Immediately above the present Long Bridge I propose to make a dam, having a lock to communicate with the Lagan, which it is deemed advisable to pen up, and would accommodate vessels belonging to that navigation to any extent. The construction of the above would require a new channel for the Lagan. This I propose to make between the Long Bridge and Ballymacarret, and to have a weir with regulating gates and sluices, and a permanent bridge over it. The present great thoroughfare between the two populous counties of Down and Antrim would thus be preserved uninterrupted, and would communicate equally with Chichester and Ann Streets and the centre of the town, as it would not be advisable to bring large vessels higher up than the third dock, on account of the *delay, inconvenience, and expense.*

The land above the bridge, adjoining Chichester and May Streets, would become good building ground; and the space between the Long Bridge and Ballymacarret would be more valuable, having both a dock and tide frontage.

The new channel for the Lagan would be direct, and would preserve itself open far better; and being conducted downwards, as shown upon the plan, would keep open the entrance to the ship canal near Garmoyle; colliers and other small coasting vessels would then have the option of coming directly up with the tide, and of discharging along an additional line of quays at the back of the docks, which might be continued to any extent as required; and by constructing locks to communicate with the docks, they might take or discharge their cargoes as most advisable either in the docks or in a tide river, which would be a great saving both of time and expense to them.

The dam, weir, and sluices, across the old and new channels, would amount, together with the new course of the Lagan, to 26,500*l*., making a total estimate for the canal, three docks, and alteration of the Lagan, 370,482*l*.; and supposing that the locks to communicate with the tide river should be necessary, an additional sum would be required for them.

The port of Belfast thus improved would be one of the most complete in the kingdom, and the whole or any part of the above estimate might be expended only in proportion as the trade might require. If the expense of a close canal should be objected to, an open one might be made at a considerable saving, namely, 21,407*l*.

I am, &c.,
JOHN RENNIE

To the Commissioners for Improving the Port of Belfast.

No. 110.
Walker and Burges, on the improvement of the Harbour.

No. 110.

Report of Messrs. WALKER *and* BURGES, *Civil Engineers, on the Improvement of the Harbour of Belfast.*

10th *July*, 1830.

GENTLEMEN,

The substance of your resolution, dated the 12th of March last, communicated by your Secretary, Mr. Lewis, is, "That Mr. Walker be requested to visit Belfast, and give an opinion as to the best mode of improving the port, by the construction of a Floating Dock, or otherwise."

In compliance with this resolution Mr. Walker visited Belfast early in April, when he attended several of your metings, and in addition to the surveys and inquiries made during his stay, the plans and reports of the engineers who have at various times been employed were given him for examination.

Since Mr. Walker's return we have given our attention to the subject, and have now to lay before you, as the result of the best opinion we have been able to form, two designs for the improvement of the river Lagan and the formation of Docks. If we shall have succeeded in proposing a plan which may be considered free from some of the objections that have been urged against the other schemes, much of the credit must be ascribed to the advantages which we have had in examining those plans, and hearing them discussed by those most concerned in the welfare and prosperity of the port.

It will probably be thought superfluous for us to add much to what has been said by others, as to the necessity of providing better accommodation for the growing trade of Belfast, and of keeping pace with the improvements made in other ports. Every individual of your body appeared to be convinced of this, and the same opinion is, we believe, held by all who take an interest in the commerce of the town.

Extent and Increase of Trade.—It may, however, be proper to remark, that the tonnage of vessels that entered the port in 1829 was greater than in 1828, and that previously to 1829 the tonnage of each year has, with two exceptions only, been greater than that of the year preceding. We have given a return* from 1786 to 1829, by which it appears that the tonnage of 1805 was nearly twice that of 1786, a period of nineteen years; that from 1805 to 1820, a period of fifteen years, it was again nearly doubled; and from 1820 to 1829, a period of only *nine* years, it was a third time doubled. The greater number of steam-packets † is without doubt partly the cause of the rapid advance within the last nine years; but independently of this, the statement shows a very great increase. By comparing the amount of 1786 with that of 1829 it appears that within this period of forty-three years the tonnage has increased about *sevenfold*, or it has, on the average, been nearly doubled every *sixteen* years.

Present Accommodation for Shipping.—The accommodation for all this trade consists of:—

Hanover Quay, which is	. . .	550 feet long.
Merchant's Quay, which is	. . .	160 ,,
Donegal Quay, which is	. . .	860 ,,
Ritchie's Quay, which is	. . .	210 ,,

Making a total length of quayage of 1780 feet, or say in round numbers 1800 feet, of which length only one-half, or 900 feet, is adapted for vessels of any considerable burthen; and even this is extremely inconvenient, from the quay walls not having been built for the depth of water now required.

There are in addition to the above three tide-docks or slips, viz. Merchant's Dock, Limekiln Dock, and Ritchie's Dock, which are very useful at present, but are capable of receiving boats or small sloops only.

Insufficiency of Accommodation.—For the trade we have described it must be admitted that such accommodation is very inadequate; and as 7 feet at low water, and 14 feet at high water of neap tides are the greatest depths at any of the quays, it is natural that the owners of heavy vessels should, rather than incur the risk and loss arising from the want of water to float their ships to the quays, and enable the time of their getting away to be calculated upon, or from the injury to which they are liable from

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* Return of the number and tonnage of vessels that entered the Port of Belfast, from 1786 to 1829, inclusive:—

Year.	Vessels.	Tons.	Year.	Vessels.	Tons.	Year.	Vessels.	Tons.
1786	761	38,421	1815	1134	91,471	1825	2060	183,441
1790	806	48,131	1820	1477	127,335	1826	2012	209,253
1795	869	52,234	1821	1533	136,495	1827	2144	219,148
1800	856	67,855	1822	1705	153,500	1828	2390	241,560
1805	894	69,582	1823	1760	152,437	1829	2493	257,522
1810	1105	95,211	1824	1973	175,294			

The above account, to 1820 inclusive, is taken from Mr. John Rennie's Report of August, 1826. The return since 1820 was received from Mr. Lewis.

† The tonnage of a steam-boat is reckoned at two-thirds of the builder's measurement.

straining, prefer unloading them at Garmoyle, three miles from the town, and sending their cargoes up in lighters, notwithstanding the inconvenience, certain delay, and additional expense thereby incurred, all of which are considerable. We have been told that but few instances of serious damage to vessels have occurred; but we believe that every heavily laden vessel is more or less damaged by being allowed to ground, and this is more particularly the case with sharp-built ships, suitable for the present race of competition. Instances of special damage not having been more frequent may have arisen, also, from the vessels intended for the Belfast trade being of such a size and form as not to suffer from grounding, while those of heavy burthen and sharp build submit to the inconvenience of remaining at Garmoyle. And this, we conceive, may likewise account for the comparatively small number of large ships frequenting the port of Belfast; for we observe that of 2400 vessels which entered in 1828, only 42 were above 300 tons, the inconvenience of the harbour thus acting as a prohibition to large vessels. Captain Caughey, the dock-master, stated to Mr. Walker, as a specimen of the utmost which has been accomplished, that a ship drawing 14 feet 2 inches came up to Donegal quay when there were 7 feet 6 inches of water on the old graving-dock gates.* It appears, therefore, that 13½ feet is the greatest draught with which a vessel can reach Donegal quay at the high water of a neap, and 16½ feet at that of a spring tide. The regular London traders, which draw from 11 to 12 feet, were said by Captain Caughey to be able to get to and from the lower quays at the high water of all tides, and this is nearly as much as can be depended upon.

Demurrage of Vessels.—When the expedition with which large vessels can be dispatched in docks where there are proper conveniences, is contrasted with the time necessarily occupied at Garmoyle, the disadvantages of the present state of the port become more apparent. We happen to know that some weeks ago a West India ship of 320 tons, with a cargo of 560 hogsheads of sugar, came into the West India Docks here, was cleared at the Custom-house, unloaded, taken into the river, examined and caulked on the *ways*, returned into the dock, supplied with ballast and stores, was again in the Thames, and started on another voyage, all within *three days*, or *seventy-two hours* from the time of her first entering the docks. About the same time the cargo of another West Indiaman of 334 tons, consisting of 467 hogsheads of sugar and 105 casks of rum, was unloaded in *nine hours*. These may be taken rather as examples of extraordinary dispatch; but the usual time for unloading a ship of 500 hogsheads of sugar is stated to be about two, or from two to three days, according to the state of the casks; yet the merchants' counting-houses are from two miles and a half to three miles from the docks. To unload such a cargo at Garmoyle would probably take two weeks, so that if the value of a ship of that size, with wages, &c. be taken at 5*l.* per day, the loss under this head alone would not be less than 50*l.* Then there are the expense of lighterage, the risk of pillage, the detention of cargo—all considerable—so that the wonder rather is that ships of burden go to Belfast at all, than that there are so few.

Other Ports improving.—If the other ports of the kingdom were as they have been, or even if they were to remain as they now are, then, as dispatch and accommodation are comparative, and as the estuary, or lough is so secure, Belfast might hold its place, and its trade might continue to increase; but when London, Dublin, Liverpool, Bristol, Hull, Goole, Carnarvon, Leith, Port-Glasgow, Greenock, Aberdeen, Dundee, and other places, either have already improved, or are on the point of improving, by the formation of docks and otherwise, even the very great natural advantages which Belfast has, until within three miles of the town, cannot, without something being done, secure to the port a continuance or increase of the trade it has enjoyed.

Liverpool Docks.—There appeared a general impression as to the expediency of the improvements being gradual, and a great apprehension of heavy charges and getting into debt. This is natural and proper, although, notwithstanding their heavy debts, the flourishing state of ports that have good accommodation is encouraging. The number of vessels that entered the port of Liverpool fifty years ago† was smaller than the number at Belfast in 1828: at that time there was difficulty in raising a loan of 10,000*l.* for a dock enlargement. You are aware how the docks, and the debt, and the importance of Liverpool has since increased. The present debt of the Dock Trust is 1,200,000*l.*, with power to borrow 200,000*l.* more, which the Trustees will not, we dare say, hesitate to exercise, or even to apply for greater power, if a further extension of dock-room shall appear requisite; and we know that they have offers to lend to ten times the amount of their present power to borrow. Yet, when compared with Belfast, the Liverpool rates are high: the dock-bill there for a ship of 200 tons register, with a cargo of 300 tons of sugar, amounts to 52*l.* 10*s.*, being 5*s.* 3*d.* per register ton.‡ In Belfast the charge is only *seven pence* per ton; and yet, as was stated by one of the members of your Board, Liverpool is cheaper than Belfast, if the demurrage of vessels is taken into account.

General Scheme for gradual Improvements.—As, however, Liverpool has attained its present degree of eminence and dock accommodation progressively, it may be well and safe, knowing the feelings of the parties interested, that Belfast should follow the same gradual course; and accordingly, in considering this important subject, the objects we have kept in view have been—

1. To make the design so that the improvements be such as may be carried into effect by degrees, each step or measure being quite complete in itself, but at the same time a part of a great and connected whole which may be extended, and the remaining parts executed as the trade of the port may require and the means of payment may justify.

2. In pursuance of this general plan to construct, in the first instance, one floating dock, as near the town as possible, with proper quays and accommodations, so as to remove the objections which we

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* Captain Caughey states, seven feet on the sill of the old graving dock-gates, as the average high-water of a neap, and 10 feet as that of a spring tide, which particulars agree with our observations.

† Account of the number and tonnage of vessels, and the dock duties at Liverpool, from 1760 to 1829 inclusive:—

Year.	Vessels.	Tonnage.	Duties.
1760	1,245	..	£2,330
1765	1,930	..	3,455
1770	2,073	..	4,143
1775	2,291	..	5,384
1780	2,261	..	3,528
1785	3,429	..	8,411
1790	4,223	..	10,037
1795	3,948	..	9,369
1800	4,746	450,060	23,380
1805	4,618	463,482	33,365
1810	6,729	734,391	65,782
1815	6,440	709,849	£76,915
1820	7,276	805,033	94,413
1821	7,810	839,848	94,556
1822	8,136	892,902	102,404
1823	8,916	1,010,819	115,783
1824	10,001	1,180,914	130,912
1825	10,837	1,223,820	128,692
1826	9,601	1,228,318	131,001
1827	9,592	1,225,313	134,473
1828	10,703	1,311,111	141,370
1829	11,383	1,387,957	147,327

The Liverpool docks *in use* have an area of 47 acres; those now *in progress* 43 acres.

‡ Liverpool Dock Bill for a ship of 200 tons, with a cargo of sugar from Jamaica:—

Dockage and harbour lights on the ship,	200 tons at 2*s.* 3*d.*	£22	10
Dock duty on cargo of sugar . . .	300 tons at 2*s.* 0*d.*	30	0
		£52	10

The ship having paid inwards is exempt on her outward voyage; but if she load a cargo outwards, the *goods* are liable to duty, which may amount to from £5 to £10, according to the description of them.

The dock-duties on a ship of 200 tons, laden with cotton, from the United States of America, would amount to about the same as the above.

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have already stated as existing to the present system, and at the same time to provide sufficient space for future works.

3. Not to injure the property adjoining the present quays, but rather to extend and improve these quays, should it be found necessary or advantageous to do so: in fact, to make the improvement of the present harbour a part of the plan.

Designs for Wet Dock.—The first division of our design for the improvement of the port of Belfast consists, then, of a Wet Dock, with the necessary deepening and straightening of the river Lagan, to form a convenient approach to it. For this dock two plans are proposed, each of which has its peculiar advantages; and as we are unacquainted with the comparative expense of the ground in the respective sites, we think it better to submit both schemes for your consideration. A reference to the accompanying plan will enable you to understand the designs generally; but a brief description may also be necessary, with a view to explain the order of proceeding which we propose.

Plan A.—By the plan on which the dock is marked A. it is intended:—

1. To deepen the present channel of the river from Garmoyle to the Buoy of the Flats, near the mouth of the Sea channel, and to make a new cut for the river from that point, in the direction of the old North Channel, to near the Flat Perch, from which to deepen the present channel up to the Milewater Perch: the depth throughout to be 12 feet at low water.

2. From a little above the Milewater Perch to form a straight cut or channel for the river to the upper end of the Ballast Bank Reach: this also to be 12 feet deep at low water.

3. To form a recess with 15 feet at low water, in which a few vessels may be moored without receiving injury from taking the ground, should they come up too late in the tide to enter the dock; and to construct an entrance lock 180 feet long, 48 feet wide, and 12 feet under low water to the proposed dock. In order to render this part perfect a quay-wall 1000 feet long, with 12 feet at low water in front of it, is carried from the wing-wall of the lock up to the Corporation ground. The expense of this is included in the estimate.

4. To make a Wet Dock, extending in length from east to west 1200 feet, and in width 400 feet, being an area of about 11 acres, with a quayage 3100 feet long; the depth to be as in the river and lock, viz., 12 feet under low water; the quays to be formed 200 feet, and the surrounding road 60 feet wide.

Estimate.—The estimate of all the works above specified, including contingencies, is 180,000*l.*

Site.—In this plan a continuation of York-street northward to the Carrickfergus-road forms the western boundary of the west quay, and Trafalgar-street, which is to be widened, continued to York-street at the one end, and to the river at the other, is the southern boundary of the south quay.* The road behind the north quay extends to the turn in the Carrickfergus-road; but to provide for the soil to be deposited, and for other purposes connected with the works, as well as for the future docks and other improvements shown in dotted lines on the plan, it will be advisable to purchase the land as far as the Milewater stream northward, and the Carrickfergus-road westward.

Plan B.—By the other design, marked B, and attached to the general plan, it is proposed:—†

1. To straighten and deepen the river from Garmoyle up to near the Milewater Perch, as has already been described, this part being common to the two plans proposed by us.

2. To form an embanked cut or canal, 250 feet wide and 12 feet deep at low water, from the Milewater Perch to the proposed dock; a length of 400 feet nearest the entrance to be widened, and to have 15 feet at low water, thus forming a kind of tide-basin, in which vessels may safely lie in case of their being prevented from entering the dock the same tide they come up the canal. This basin will also tend to increase the stillness of the water at the lock gates, which object may be still further secured by jetties or breakwaters at the end of the basin, as sketched on the plan, should they be found requisite.

3. To construct an entrance-lock of the dimensions specified for Plan A.

4. To make a Wet Dock 1400 feet long and 400 feet wide, being an area of about 13 acres, with a quayage of 3500 feet; the depth to be as before, viz., 12 feet under low water; the quays also 200 feet, and the road 60 feet wide.

Estimate.—The Estimate of these works, with contingencies, is 157,000*l.*; or if a second lock, with an opening bridge, &c. to communicate between the upper or south end of the dock and the present harbour be thought expedient, the amount, including a sum for the continuation of the quay-wall up to the Corporation ground (a length of about 300 feet) will be 210,000*l.*

Site.—A good idea of the situation of this dock may be formed by considering Corporation-street, continued northward, as the extreme boundary of the improvements, to which the quays and dock are to run parallel, and extend from the Corporation-yard, over Mr. M'Laine's ship-yard, and along the whole length of Messrs. Dunbar and Holmes's ground, to near the Mile-water stream. As we think it very important, wherever the first dock may be placed, to have the opportunity of future extension, we have here also shown the situations for prospective works; and in the event of this plan being adopted, would recommend the immediate purchases to extend northward quite through Mr. Thompson's reclaimed ground, as far as the extreme road shown on the plan by dotted lines.

The expense of warehouses, sheds, cranes and boundary walls is not included in either of the above estimates.‡ A sufficient number of proper moorings, warping buoys, capstans, &c., is provided for.

Depth of water in Dock.—The depth of water in the dock will never be less than 19 feet, the height at a neap tide, but generally nearer 22 feet, that at a spring tide:—indeed we think that by turning at proper times the stream of the Mile-water rivulet into the dock, it may almost always be kept up to the level of high water of spring tides. Or, if at any time the river Lagan be dammed up above the bridge in the manner afterwards described, the depth of 22 feet may at all times be maintained in the dock, though there must be some expense attending this in the first instance from a culvert or pipe being required to convey the water under the town.

Comparison of Plans proposed.—The distance from the junction of Mary-street with Waring-street to the nearest point of the dock, is nearly the same by the two plans, but the plan A is more convenient for a communication with York-street, and that part of the town.

Plan A has the advantage of straightening and deepening the whole length of the river, while the other design, so far as described, leaves one of the awkward bends as it is. By both plans, however, a great improvement will be effected on the passage to the present quays, which may be left for vessels of a smaller class until your funds enable you to make the improvements on them hereafter stated. The accommodation given by the works already detailed will be ample for the present trade of Belfast, and will allow for a very considerable increase, dock-room being afforded for from ninety to a hundred large ships which may enter the dock or get to sea at all times.

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* One of the docks shown in Mr. John Rennie's last design is not in point of situation much different from that just described: his dock is much larger, but the quays are narrower than ours.

† This plan is not lithographed, plan A having been adopted.

‡ The number of cranes required depends upon, and must, of course, vary with the extent of the trade. A boundary wall, 14 feet high above the road, and carried completely round the outside of the quays of the dock, will cost from £13,000 to £14,000.

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The canal and basin are peculiar to plan B, and the banks may be useful and valuable.

If the upper lock be made, the plan B will have the convenience of two locks, by which double the business of docking and undocking may be done each tide. In this an additional establishment of lock-men would be requisite, but though one entrance might be sufficient for the wants of the trade, there is an advantage in having two locks, as, in case of accident to one, the other would be effective. Almost all the Liverpool docks have two entrances: so, also, the Hull docks. In the Thames the West India and the London docks have each two entrance locks; the East India and the St. Katherine's only one entrance lock and an entrance basin each, while the Commercial docks have but one lock and no basin. We do not remember any very serious evil having occurred at any of these establishments, but the Commercial dock directors have at various times proposed an additional entrance.

By both plans, you will observe that provision is made for graving-docks, slips, &c., should they be found expedient.

On a general comparison of the designs, we consider that, as regards accommodation and convenience, the difference between them is not important; and in the event of the plans generally being approved, we shall, in case of future reference to us, be better able to give a correct comparative opinion, if you will procure a valuation of the property in their respective sites.

Objection to proposed Sites on account of distance.—The only objection which we think likely to be made to either of the sites is the distance from the trading parts of the town, the nearest point of either dock being 800 yards from the junction of Mary-street and Waring-street. The reply to this is, that unless the river in front of the present quays be converted into docks, there is no situation nearer town than what we have proposed, except that of which Great George-street would form the southern boundary; but the purchase of this site would, from the buildings which now occupy some parts, and from the value of the ground generally for building purposes, be enormously expensive:—besides, the nearest point of the dock, in this place, would still be upwards of 500 yards from our starting-point at Mary-street; the area would be small and confined, even for one dock, and objectionable as the site is on this account, it is more so from the want of opportunity of future extension. We may also remark, that there are a considerable and increasing population and several large warehouses and buildings in the neighbourhood of the sites proposed by us; that the distance did not appear objectionable to the Commissioners of Customs, when in 1815 they reported in favour of a Custom-house Dock and stores nearly in the same situation; that the difference of distance from Mary-street to Donegal Quay, and from the same point to the proposed dock, does not much exceed a quarter of a mile; and taking the meeting of Donegal-street and York-street as the starting point, the distances are, by plan A, nearly equal; that, while the accommodation for shipping will be much enlarged and improved, the additional expense of carting that may arise from the increase of distance, is much more than counterbalanced by the delay caused by the business being crowded on the present quays, or in a confined dock; and lastly, that as by the plans we propose, these quays will be left open, and may be improved, the comparison of distance, with reference to docks placed in front of the town, should be rather with the quays that would be formed on the Downshire side, than with those in the place of the present quays on the Antrim side of the river.

Cartage from Docks in River Thames.—The nearest point of the West India Docks in London, to the average delivery in the city, is about three miles; from the London Docks the distance is about a mile and a quarter, and from the St. Katherine's Docks only about seven-eighths of a mile. The comparative distance from the city is therefore as three to one: the rate of cartage does not exceed one and a quarter to one; and what is still more in point, the rates of cartage from the London Docks and the St. Katherine's Docks are the same, although the latter establishment is a third of a mile, or from 500 to 600 yards nearer the city.

Harbour Improvements.—Our opinion is, that the works we have described, should be the first in order: they are completely independent of what we are about to detail, which may be either proceeded with immediately, or at a future time, when it may be necessary further to extend the accommodation of the port. These may be denominated "Improvements of the present Harbour," and consist of the following works, viz:—

1.—Deepening the present harbour from the corporation ground up to the bridge, and widening the same, so as to have a depth of 12 feet, and a width of 350 feet, at low water in every part.

2.—Building new quay-walls, with landing-stairs, moorings, &c., in front of the present quays, but extending further into the river, so as to have in all parts a width of at least 150 feet for the quays and roads in rear of them:—the depth of foundation to correspond with the proposed depth of 12 feet at low water.

Estimates.—The estimate of these works according to plan A, is, with contingencies, 78,000*l.*: according to plan B, which, in addition to the above, includes a new cut for the river, and deepening from near the Mile-water perch, where the canal to the dock branches off, up to the corporation ground, the amount is 99,000*l.*

Advantages of Plan.—The prominent advantages of this plan are, that the present sewerage of the town will not be interfered with; that all the difficulties of navigation between Garmoyle and the harbour will be got rid of; that the value of the warehouses and property near the present quays, and in the town generally, will be increased; and that, while large ships with valuable cargoes, subject to duties, will be unloaded in the dock, where they will always be afloat and secure within walls; coasters and colliers of the greatest burden will be able to get up to and leave the quays at all tides without delay; and vessels not drawing more than 12 feet, at all times of tide. For steam-vessels, in which so much of the coasting trade of goods and the conveyance of passengers is now carried on, this is a most important advantage, as it will enable them to land their passengers at the quays at all times, and to start regularly, without regard to the period of tide. Other causes of inconvenience and delay, which will be removed by the improvements, are well known to you all, and do not require any description from us.

You will observe, that the Custom-house Dock is proposed to be filled up: the expense of this, and of continuing the arched sewer under High-street, to the front of the new quay wall, is included in the estimate. Provision is also made for securing the bottom and walls of Limekiln Dock and Ritchie's Dock, which will be left open; the accommodation they afford to market-boats and small vessels, and to the buildings around, appears to us a sufficient reason for leaving them. Foot-bridges may be placed at small expense across their entrances, as shown on the plan.

General objections to Improvements.—What then are the general objections to the plans that have been proposed? They appear to us twofold, viz:—

1.—The expense of the works requiring an increase in the present rates.

2.—The tendency of the new cuts to silt up, rendering dredging necessary.

Increased Rates.—The first is an unfortunate objection that is common to almost all improvements; but if these improvements be really useful and necessary, the fear is generally greater than the actual danger. In the present case, when we see the great difficulty and detention in getting to and from the quays, and the bad accommodation there, we are sure that the merchants and owners of vessels must be so interested in the removal of the existing obstacles to their trade, that, for their own sakes, they will readily consent to such a reasonable increase of rate as will compensate for the expenditure. The Liverpool Docks have been the means of the great wealth and growth of that town; yet the rates are, as

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we have seen, greater than those at Belfast in the proportion of nine to one. It is to be noticed also, that better accommodation would increase the tonnage and the revenue, even at the present rates.

Again, if there be any difficulty as to the *means*, even the projected improvements on the quays may be progressive: the lower part (Donegal Quay) may be done first; but the expense will be less in proportion if the whole of this division be done at the same time.

Tendency to silt up.—The second objection is the tendency to silt up, and the consequent expense of maintaining the depth. This is a point to which we have given particular attention, both when on the survey and since; and our opinion is, that, although some dredging will be occasionally requisite, it will not be by any means considerable. Except in times of flood, the water of the Lagan above the tide is quite free from mud, and so also the tidal water: we observed some cuts that had been made through the flats several years ago, and they did not appear to have at all silted up, although there was little or no current through them. It is to be remarked also, that the increased velocity of the stream in times of flood prevents the mud from being deposited, and, as the intention is to contract the width of the new channel of the river nearly in proportion to the increase of depth, the tendency to silt will be confined to the harbour and the docks. We propose that the abandoned parts of the river shall be filled up, so as at all events to prevent any current through them.

Prospective Works and Purchases.—It will, we are aware, be said by some, that we have already gone too far: that even the dock improvements are more than Belfast can afford; that if these are carried into effect, there can be no occasion for the new quays and the deepening of the present harbour; but that, if from a desire to improve the present property, and to have the advantage of approaching and leaving the harbour at all times of tide without the delay of lock-gates, the new quays we have described should be required, it is quite superfluous to think of proceeding further. Our reply is, that if you commence with our first division, viz.: the Dock and the approaches to it, no other part requires to be done until the increased trade demands additional accommodation; but that experience has taught us, and we believe every one much connected with matters of this kind, the grievous mistake of not arranging the design at the outset so as to admit of extension from time to time; and we should consider our plan as indeed imperfect if this provision had been neglected, with reference either to dock or harbour room. We have already drawn your attention to the prospective works relative to the docks; the increase may be required much sooner than there is at present any idea of, and we have no hesitation in repeating our recommendation that *all* the ground should be purchased at the same time: if at first it is not all wanted for the construction of docks, it will always be available when required, and it may at once be made useful by being employed for bonding ground, timber stores, &c., and for depositing soil, and many other purposes, without provision for which your works would be very imperfect. So, also, and for the same reason as respects the extension of the harbour, we have sketched a range of quays on the Downshire side of the river, extending from the bridge downwards; and, as part of the flat on which they are drawn will be required whenever it is resolved to widen the quays on the Belfast side, we would strongly recommend your now purchasing the whole width on the Down side which our plan comprehends.

Long Bridge.—It was impossible to consider the improvement of the Harbour of Belfast without having reference to the state and position of the Long Bridge; and Mr. WALKER's attention was more particularly directed to this subject by the request of two gentlemen of the Grand Jury.

New Bridge.—That a new bridge is required, seems generally admitted: the question is, where it ought to be situated, so as to improve the town generally, without prejudice to private interests.

Site.—Our idea is, that the new bridge should be placed so that the Belfast or Antrim abutment may be about 200 yards higher up the river than the Long Bridge, while the Ballymacarret or Downshire end is removed very little from the present site. The bridge will thus be nearly in the line of May's Dock, which will be closed up and formed into a wide street; thus converting that which is at present an abominable nuisance into a spacious line of approach, which, by a few removals and roundings of corners in William-street and Corn-market, may be continued into High-street, and form an excellent communication between the bridge and the upper part of the town. This new opening will also communicate immediately with Chichester-street, and the various streets leading to it, on the one hand; and, on the other, with High-street, Ann-street, and the business part of the town, to facilitate the approach to which, you will perceive a wide and convenient road is proposed in the rear of the improved quay. An inspection of the plans will, we think, satisfy you, that a most important and useful improvement will thus be effected on the communications of the town:—there will be some expense in Corn-market and William-street, but the increased value of the new frontage will more than compensate for this.

Water-way.—We consider that a bridge of three arches, not exceeding 100 feet span each, will be ample:—this will give an area of 5000 superficial feet at high water, which is eight times the area of the sluices that discharge the whole of the river water two miles higher up, four times the water-way of Ormeau Bridge, which is only one mile higher up, and greater than the water-way of the present Long Bridge, through which the velocity is not at all considerable.

Lagan Navigation.—We have as yet said nothing of the Lagan above bridge. Although the measures we have proposed do not interfere with that navigation, we consider that it cannot be viewed with indifference, interested as the commercial town of Belfast must be in extending the facilities of communication with the interior of the country; and we think that whatever is done in the harbour should have reference to the improvements above. With this view we have given our attention to devising means for rendering the river Lagan navigable at all times of tide, and our opinion is, that, under the circumstances, the best mode of accomplishing this will be by placing sluices and a lock across the river, about 50 yards above the bridge; the sluices to be used for keeping the water at all times up to a uniform level, unless in times of flood and when it may be desirable to open them at low water in order to scour the harbour, which will occasionally be necessary to compensate for the general absence of current. By means of the lock, barges may be passed from the harbour into the river above, or from the river down to the harbour, at all times of tide. The ornament of the property above the town, and the facility of keeping the water in the dock up to the level of spring tides, as we have before mentioned, are additional advantages to be derived from this arrangement. The proposed site for the sluices and lock is shown on the plan.

Comparison with other Plans.—In comparing the probable cost of the various plans that have from time to time been proposed, it may be proper to have reference to the quantity of work intended to be done by each, as the size and number of the locks, the extent of the coffer-dams, the area of the docks, the length of the quay-walls, &c., as well as to the amount of the respective estimates, which may have been formed on different scales of prices. The locks form the most expensive item of the estimates: of these, you will observe, that by the plans now submitted, but one, or at the utmost two, will be required; and in reference to the amounts of our estimates generally, we can say that they have been formed from detailed measurements, and that the sums stated are such as we believe quite sufficient for the proper execution of the respective works.

It remains for us only to express our hope, that the ideas we have suggested for the improvement and extension of the Port of Belfast, may be considered as in some degree worthy of the confidence you have been pleased to place in us. We have a very strong opinion that the dock added to an *improved river* is better than the *substitution of docks for a river*, and this is the general idea we have kept in view in the formation of the plan.

We are, &c.,

WALKER and BURGES.

No. 111.

Mr. HALPIN'S *Report for the further improvement of the Port and Harbour of Belfast.*

No. 111.
Halpin, on the improvement of the Harbour.

SIR, *North Wall, 24th July,* 1832.

Pursuant to the directions of the Commissioners of Public Works, I proceeded to Belfast on the 9th instant, and examined the site of the proposed improvements, projected with a view to afford more commodious quays and docks, and to facilitate the passage of vessels from the anchorage at Garmoyle to the town, which is at present attended with difficulty to sharp-built ships from its circuitous course, and from the insufficient depth of water—an improvement to the trade of this prosperous port, which certainly calls for improvement.

My attention having been directed to the plan of Messrs. Walker and Burges, the adoption of which it would seem has been decided on, I will now treat of it without reference to the other projects.

These gentlemen have so fully explained the disadvantages of the present navigation, and the benefits derivable from a more direct and deeper passage, that it is unnecessary to enlarge on those points. It is proposed by them to form a floating dock eastward of the present Graving Dock, or on the opposite side of the river—to abandon the old channel—to cut a new direct one from Garmoyle to the Quays, a distance of nearly two miles—and to maintain in this channel a depth of ten feet at the low-water of spring-tides, and running trackways on those banks.

That the increased convenience for shipping, with a deeper and more direct channel, would be desirable, must be admitted; but it is to be considered how far the stated estimate may be sufficient for its execution; how far the probable revenue will suffice to keep open this new channel, to pay interest on the money proposed to be borrowed, and make a return of the principal. Also how far confining the channel between banks from the town to Garmoyle, will have a tendency to cause a silting there and on the middle bank or bar.

With respect to the estimate, I consider that sixty thousand would not make the proper portion of the work complete in itself, nor by any means suffice for increasing the water at the quays to the depth required, previous to levying a certain higher rate of dues, and that the mud could not be excavated from the proposed channel, and placed on the banks for 8*d.* the yard. The other items likewise appear to me to have been estimated low. One very important part would be the lining of the bank with stone—this Mr. Walker has viewed as a future operation, and does not include in his estimate for the more immediate works. I apprehend its execution would be absolutely requisite; the experience of the action of the water on the banks, caused by steam-vessels in the Clyde and elsewhere, point out its necessity—this would form a large addition to the estimate. It is also proposed to have a greater depth of water at the quays, and an increase of dues is made dependent on that condition. For this purpose new quays must be built in front of the old, the foundations of which will not admit of any deepening near them; for this a further large expense must be incurred, not included in the estimate for immediate works. The 42,880*l.* stated in Messrs. Walker and Burges's estimate providing only for the opening of the cut into the river opposite the Graving Dock, which I believe it is intended should be executed first.

The expense of this cut, taking the quantities given, but at a higher valuation, would be as follows:—

	£.	*s.*	*d.*
Excavation of new channel	46,212	10	0
Contingencies, as engines, dams, &c.	15,000	0	0
Facing banks with stone	15,300	0	0
Mr. M'Laine's land	8,250	0	0
Making . . .	£84,762	10	0

for the cut alone from Garmoyle to the river opposite Graving Dock. To which remain to be added the expenses of

1st.—Building new quays.
2nd.—Deepening river and quays, as required to increase dues.
3rd.—Embankments opposite new quays.
4th.—Proposed floating docks.

As the present quays are private property, the purchase of the right of them will be expensive. I am apprehensive that the probable revenue of this port, admitting a progressive increase of the trade and the imposition of higher dues, will not suffice to repay the interest of the sum now proposed to be borrowed, to make a gradual return of the principal, and to keep open the proposed new channel, which will have a strong tendency to fill up to the natural bed of the river, and to maintain which at the proposed depth will require constant dredging. The operations of the last ten years seem to have effected no improvement in deepening the channel. On comparing soundings I have taken with those by Mr. Rennie in 1820, there appears rather a shoaling of the water, unless in the reaches where ballast has been dredged. Much also of the excavation made during that period has returned a profit for ballast, while in the new channel the mud will not answer for that purpose. The nature of the slabs or mud-banks below the town shows that the Lagan must bring down large quantities of earthy matter in the time of floods, much of which at present is deposited on the flats on either side of the channel, between the town and Garmoyle. But when the channel would be confined between banks for that distance, the stream would necessarily carry a considerable portion of the silt further out, and deposit it at and below Garmoyle, where also it would be necessary to resort to dredging at no distant period.

Having given my best attention to the various plans for the improvement of the navigation from Garmoyle to Belfast—a subject of so great importance not only to the trade of Belfast, but to much of the North of Ireland connected with it; and, considering the great annual expense of keeping open the proposed channel, it is my opinion that a communication by canal, as proposed by Messrs. Telford and Rennie, would be more effectual than that now chosen by the corporation of Belfast. Though more expensive in execution, it would insure a constant depth of water to the quays, and its cost of maintenance would be inconsiderable.

I have, &c.,
GEORGE HALPIN.

Henry R. Paine, Esq., &c. &c. &c.

No. 112.

First Report on the Improvement of Belfast Harbour.—By THOMAS J. WOODHOUSE, Esq., C.E.

No. 112.
Woodhouse's first Report on the Harbour.

GENTLEMEN, *10th September,* 1834.

In complying with your instructions to make a Report on the improvement of the Harbour of Belfast, I must acknowledge I feel somewhat diffident in giving an opinion, after the most eminent persons in the profession have done so; although, with the advantage of having the whole of their plans and suggestions before me, my task is comparatively easy, the names alone of the gentlemen who formed the different designs for improving the harbour are sufficient to warrant the utility of them. I allude to those particularly of the Messrs. Rennie, Telford, Walker, and Burges; but it appears to me they have each fallen into a somewhat similar error, namely, that of projecting plans on too extensive and too expensive

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a scale for the trade of the port, or for the finances or resources of the corporation, for preserving and improving it.

The plan of Messrs. Walker and Burges has one great advantage over the others, which is, that it admits of being carried into effect, as Mr. Walker justly observes, "by degrees, each step or measure being quite complete in itself, but, at the same time, a part of a great connected whole." That such should be the case is very desirable indeed, especially as the finances of the corporation are limited.

So much has already been said in the Reports of the gentlemen I have named, on the bad state of the navigation to Belfast, both as regards its sinuosities, and want of sufficient depth of water, that I need only remark, that the improvement of the channel is, undeniably, the primary object which demands attention. At present there is water sufficient for any vessel frequenting the port, as far as Garmoyle; but from that upwards the channel shoals, until at the town there is not more than from 4 to 6 feet at low water.

The manner of improving the channel from Garmoyle, is a subject on which much difference of opinion has arisen. Messrs. Rennie and Telford have each recommended a close canal to be made from that place to the town, converting the river opposite the present quays into a floating dock; and Messrs. Walker and Burges have suggested the propriety of making an open cut or canal, thereby straightening the channel, and deepening other parts of it, which would form part of the improved channel.

The objections to the close canal are the great expense attendant upon it; and that, even at the outset, the construction of the necessary locks, tide basin, &c., would require greater funds than it appears probable could be raised, or the trade of the port could afford, without an injurious burden; again, considerable outlay and inconvenience would be incurred in disposing of the sewerage of the town, also the flood-waters of the Lagan; not but I am willing to allow that these matters would be easily accomplished, were the means at command.

On the other hand, the principal objection raised to Messrs. Walker and Burges's scheme of an open cut, is its liability to an accumulation of silt or mud from the waters of the Lagan; I must confess I consider the objections are not substantial, and think the remarks those gentlemen have made in their last Report, of the 4th September, 1832, on that subject, are unanswerable and not to be controverted. Surely a straight channel will have less tendency to occasion deposit than a crooked or circuitous one. Wherever there are abrupt turnings in a water-course, eddies and dead water occur, and consequently deposit, if the water be at all charged with earthy matter. Then again, as to the suggestion that a bar will be formed at or near Garmoyle, if the straight cut be made, I think with Mr. Walker, that as much deposit has already taken place there as the current will allow to remain, no sensible difference being perceivable since any recorded observations have been made upon it; and, as I consider, he justly observes, the channel and stream are long since in equilibrio at that place.

A very material recommendation to the open cut or channel is, that if at any future period it should be found necessary or desirable to make a close canal, that the work proposed to be done would be in every way suitable for it, either as regards direction or dimensions; and, in fact, it might form part of most plans which have been or, I think, can be judiciously recommended for the improvement of the port and harbour.

Having so far premised my remarks on the different plans which have been projected, I shall now proceed to lay before you what I consider will be the most effective and economical step towards the improvement of the port.

To make the navigation perfect, it will be necessary to form a straight cut from the entrance to Messrs. Dunbar and Holmes's Dock to near the old Mile-water Perch; then for a short length to deepen the present Channel; and then make another straight cut in the direction of the old North Channel to the buoy of the flats, near the mouth of the Seal Channel, from which place seaward there is alwas sufficient water.

The improvements above named form two distinct pieces of work; therefore, as the navigation from the town to the Mile-water Perch is much worse (as regards the depth of water) than the part below, I propose that the first work to be undertaken be the new cut or channel from the entrance to Dunbar and Holmes's Dock to the present channel near the Mile-water Perch. The accompanying plan and section show the direction and dimensions of the intended cut. The dimensions I have adopted are 250 feet at low water level, and 300 feet at high-water spring tides. The depth of water to be 10 feet at low-water. The slopes to be 2 to 1 to low-water level, and 2½ to 1 above that level; and considering the lightness of the material through which the cut has to be made. I do not consider it would be prudent to make them less; also, for the same reason, I would strongly recommend the slopes on both sides of the cut to be faced with a rough stone pavement, which will be the only effectual protection against the banks being cut or washed by the action of the water, as well in rough weather, as from the motion occasioned by steam or other vessels passing along it. The stone facing will increase the expense several thousand pounds; but the work will be so much the more complete and durable with it, that I consider it indispensable.

The following estimate for that part of the work is made from detailed measurements, upon what, I am satisfied, are ample prices, including a per centage sufficient to guard against any probable contingencies that may arise.

Estimate of the Expense of forming a New Cut from the entrance to Messrs. Dunbar and Holmes's Dock, *to* near the Mile-water Perch, of the dimensions shown and described on the Section, including Stone Pavement for both the inner slopes:—

Excavation, including wear and tear, and deterioration of dredging engines, scows, &c.	£19,158
Stone facing to slopes	6,522
Timber bridge over the Mile-water river	250
Gravelling towing-path on both sides of cut	300
Per centage on the above for contingencies	2,623
	£28,853
To the above must be added the property to be purchased from Messrs. Dunbar and Holmes, also from Mr. Thompson, say about . .	1,200
	£30,053

In the above estimate, I have not included the cost of deepening the channel, from the end of the proposed new cut to the upper end of Donegal Quay, the depth of which I consider should be increased to 10 feet at low water, at the end of the cut, gradually diminishing to 5 feet at the upper end, and to be made 200 feet wide at low water level; the expense of that portion of the work would be something more than 2000*l.*; but if the new cut were determined to be made, the dredging engine, which is at present deepening the old channel, might be employed in effecting the above, which would be done before the cut was completed, without an increase of the present expenditure.

In connection with the before-mentioned improvements, I consider it very desirable to construct a ballast quay, on which a stock of ballast might always be kept, and vessels in receiving it would be clear of the general business of the port; also leaving the quay at the Corporation Dock available for other purposes. I have shown it on the plan in what appears to me to be the best site, and I have also sketched in the situation of a dam to be made across the old channel (as soon as the new cut is opened), which would form an excellent harbour for vessels out of use, or waiting for cargoes, and would be useful for many purposes.

In making the new cut, the quantity to be excavated very far exceeds what is required for forming the necessary embankments, which surplus might be very advantageously employed in reclaiming some portion of the present slabs or mud-banks; but that would require the co-operation of the owners of property,

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as some extra expense would be incurred beyond the cost of depositing it in the most convenient place. I have sketched my ideas on that subject, by which, not only the piece of ground adjoining Mr. Thompson's may be reclaimed, but likewise a large tract on the county of Down side, opposite Ballymacarret, which may ultimately be converted into quays, docks, &c. I think it is an opportunity which the owners of property ought not to lose sight of.

In considering the improvement of the port generally, I think the corporation should, if possible, purchase the whole of the present quays, under the powers vested in it by the Act of Parliament. Were that done, some general plan for widening and improving them might be laid down,—and although the whole were not effected at once, it might progress as the funds of the corporation permitted, and, when completed, would form a perfect and uniform work; whereas, if left to the caprice of individuals, each will have his own ideas of improvement, and a want of co-operation will prevent the quays giving that facility to the trade which they might be made capable of.

I consider they ought to be so far improved as to enable steamers and other vessels, not drawing more than 10 or 11 feet of water, to run alongside of them, even at low water; the accommodation that would afford to the trade of the port needs no comment.

The improvement of the navigation in the manner proposed will certainly afford great advantages to vessels frequenting the port of Belfast over those which they at present possess, and will do away with some of the greatest objections to which it is liable; but still I am of opinion, the work will be incomplete as a whole until a floating dock is constructed, in which vessels may lie in safety at all times, without the danger of grounding, which ought to be always avoided, if possible, with ships of large burden.

Many opinions have been speculated on the best site for that purpose, but that will be a subject for future consideration. I need only again repeat, that the cut I recommend would form a channel, as far as I am aware, to any dock which has been designed; and in this Report, instead of suggesting improvements on a magnificent scale, and far beyond any means the corporation has at its disposal, I have endeavoured to confine myself principally to such works as will be essentially useful to the port; and, at the same time, the outlay so moderate, as to give a reasonable hope of the necessary sum being obtained.

Having said so much as respects the proposed improvements, it may now be well to take a cursory view of the *means* which the corporation has at its command to effect them; or, perhaps, more properly, what security it has to offer for a loan for that purpose, it being understood there are no immediate funds at its disposal. I will premise by saying, that the cut being complete, and the channel deepened in the manner I have described, there will no longer be any obstruction to prevent vessels, drawing 14 feet water, coming up to the quays with any tide; therefore the corporation would be entitled to charge the full dues or tonnage set forth in the Act; and further, that on the commencement of the works, it would also be entitled, both in law and equity, to charge one moiety of the dues over and above 2*d.* per ton now charged. In the following calculation, I assume the trade to be 162,000 tons, exclusive of colliers, and that one-sixth part of that quantity is liable to the higher rate of 10*d.* per ton:—

				£.	s.	d.
The annual receipts (including 2*d.* per ton, in part of the Parliamentary dues), exceed the present expenditure, in round numbers				2,000	0	0
One moiety of the remainder of the Parliamentary dues on 162,000 tons, at 2¼*d.* on an average, would produce . . .				1,518	15	0
To repay the sum of 35,000*l.*, by instalments, in 20 years	£1,750	0	0			
Interest on the loan at 4 per cent. gradually diminishing	1,000	0	0			
May be taken on an average at . .				2,750	0	0
Surplus, with one moiety of the dues				768	15	0
Add the other moiety				1,518	15	0
Annual surplus for further improvements, when the full tonnage is charged				£2,187	10	0

In making the above statement, the trade of the port is taken as at present; but by referring to the returns for the last 50 years, it may be seen the trade has doubled in each 15 or 16 years. If such rapid increase has taken place, with all the difficulties and disadvantages attendant on the present bad state of the navigation, how much more may it fairly be expected to increase, with the facilities which will be afforded by the projected improvements?

I have the honour to be, Gentlemen,
Your obedient servant,
THOS. J. WOODHOUSE.

To the Commissioners of Public Works.

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Woodhouse's Second Report on the Harbour.

No. 113.

Second Report on the Improvement of Belfast Harbour. By THOMAS J. WOODHOUSE, Esq., C.E.

GENTLEMEN, *Belfast*, *22nd October*, 1834.

Since your last meeting, I have attentively considered the objections raised to the straight open cut, as recommended in my report of the 10th September; and the only one which I conceive is in the least substantial, is the apprehension that the waters of the Lagan, passing through, and being confined to the cut, may form a bar at or near Garmoyle; although I must again repeat, I do not think it likely to be the case; still, if there be the least probability of that taking place, it is highly necessary to guard against it.

After a great deal of consideration on the subject, the following addition to my former plan has occurred to me, by which, I conceive, all danger of such a result from the straight cut being made, will be removed, and in other respects, much improvement made.

The method I propose is, to keep the channel for the shipping *unconnected* with the one for the waters of the Lagan. To effect that, it will be necessary to construct a lock for the trade of the Lagan, immediately above the arch of the Long Bridge, through which it passes; or, perhaps, it would be better to place the lock opposite the third or fourth arch from the town, so as to allow of the Custom House quay being widened at any future period. Several of the adjoining arches will require to be dammed up, and the channel for the Lagan turned through the arches on the Down side, and a cut made from thence to the present channel, below Dunbar's dock. An embankment must be made between the old and new channels, from the Long Bridge to the point last named; and a dam formed across the present channel, to connect with the bank of the new cut, or tidal course, for the shipping. That dam would form an excellent ballast quay, one side for lighters discharging, and the other side for ships taking it in.

It appears to me, the effect of this arrangement will be, that the waters of the Lagan will flow over the slobs or mud banks as at present, and on them deposit the earthy matter with which they are charged; and, consequently, when they reach Garmoyle, will be as pure as they are under existing circumstances, and as little likely to form a bar, at that place. And again, that the water flowing up the new channel to

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the town, will be principally pure sea-water, whereby all deposit in it will be avoided, and the expense of dredging altogether saved; which saving alone will in a very short time repay the expense incurred in executing the extra work.

It perhaps will be said that this plan would preclude improvement in the way of quays, &c., on the Down side of the river, by turning the channel of the Lagan; however, I consider it would be the first step towards reclaiming and improving that property; a large portion of which (with the co-operation of the owners), might be taken in at the time the cut is making. If extensive improvements are contemplated on that side of the river, it will be necessary to resort to the plan suggested by Messrs. Rennie and Telford, of making a new channel for the Lagan, through or eastward of Ballymacarret.

Some difficulty may arise in carrying this plan into effect, by the grand juries of Antrim and Down objecting to the Long Bridge being interfered with; but I think there could be no reasonable ground for their doing so; and in case of a new bridge being built, which has been so long talked of, I consider the plan I propose will simplify that operation. The part of the bridge on the Antrim side would only require widening, so as to form a causeway of sufficient width, leaving ample space on the Down side for the construction of arches for passing the river Lagan.

The works I have described, may be executed at the same time the straight cut is making, or subsequently; and in adverting to them now, it is chiefly with the view of shewing, that if they were made the strongest (and I think I may say the only) objection to it would be removed.

I have, &c.,

To the Commissioners of Public Works. THOS. J. WOODHOUSE, *Civil Engineer.*

No. 114.

Cubitt's Report on the Harbour.

No. 114.

Report of WILLIAM CUBITT, Esq., C.E., *on the Improvement of the Port and Harbour of Belfast.*

16, *Parliament Street, London,*
30th May, 1835.

GENTLEMEN,

I have now the honour to report to you on the harbour of Belfast, as referred to me in a communication of the 14th ult., from H. Paine, Esq., your Secretary, accompanied with various plans, reports, and documents on the subject; a copy of which instructions, together with a list of the papers transmitted to me, and herewith returned, I have inserted in the appendix of this report, together with some subsequent correspondence, and a list of other documents, either written or printed, which have come under my notice, relative to this business.

On the receipt of my instructions and papers from Mr. Paine, I proceeded to Belfast; and, accompanied by Mr. Woodhouse, the engineer to the Harbour Corporation, and Mr. James M'Cleery, on behalf of the parties at whose instance this inquiry was entered upon; I made an inspection of the harbour and town of Belfast, from the first lock on the Lagan navigation, to the roads of Garmoyle, with a view to the improvement of the harbour. I also read the reports, and examined the plans of Messrs. Rennie, Telford, and Walker; together with the other plans and papers stated in the appendix;—also in the Act of Parliament of 1831—"*For the further Improvement of the Port of Belfast, and for other purposes.*"

Whilst at Belfast, I was favoured by an opportunity of attending a meeting of the Harbour Commissioners, to whom I communicated my instructions from the Board of Works, and in some degree, generally, my ideas with regard to the defects and the capabilities of the port. My acknowledgement are due to the meeting for the attention and full answers given to all my inquiries; and also to Mr. Lewis, the ballast master, and Mr. Woodhouse, the resident engineer, for the readiness with which all books, papers, and plans, relative to the income, expenditure, or improvements of the harbour, were submitted to my notice. I was also favoured with a visit from several gentlemen interested in the trade of the port, from whom I received valuable information as to the present deficiency of accommodation for shipping, and the effects that would be likely to ensue to the merchants and shippers, provided, of the various plans which have been before the public, any one had been carried into effect.

Having found, in the papers referred to me, some correspondence addressed to the Right Hon. Lord Templemore; and finding, on inquiry, that his interests might be materially affected by carrying into effect various plans that might be suggested for the improvement of the harbour, I addressed a note to his lordship, and was favoured with an interview on the subject; and am glad to have this opportunity of acknowledging much local information communicated by his lordship, relative to the business; and an assurance that any plan, having for its object the general improvement of the port and harbour of Belfast, upon simple and economical principles, should have his lordship's entire approbation.

After a most careful consideration of the whole subject, through the above-stated means, I am led to the following conclusions:—

First. That the plans of Messrs. Rennie, Telford, and Walker, although possessing great individual merits, are all on too large a scale, and involve a far greater expenditure than is compatible with either the wants or the means of the port—particularly the two former.

Secondly. That the plan proposed to be adopted, of taking up a loan of 35,000*l.* to carry into effect a part of Mr. Walker's plan, by making the upper cut or shortening from Dunbar's Wharf to the Milewater perch, will not answer the purposes or expectation of the Harbour Corporation, in proportion to the sum proposed to be expended upon it. And,

Thirdly. That, in my opinion, a modified plan may be adopted, which, combining the river cuts of Mr. Walker's plan with the formation of the present quays and harbour into a floating dock, would ensure all requisite accommodation for shipping and trade, and could be carried into effect at a cost quite within the means of the Commissioners to obtain powers for.

In making my observations and inquiries, I found there were certain points upon which almost all the parties I conversed with were agreed—the principal of which were:—

First. That the navigation of the river, from Garmoyle Roads up to the quays of Belfast, is in a very bad state, and ought by all means to be improved.

Secondly. That, if the depth of water in front of the quays along the town were always at the depth of an ordinary spring tide, at least double the quantity of business might be done with the present extent of quay-room; and that, in such case, no immediate necessity would exist for new docks, on fresh sites. And,

Thirdly. That no objection would be made to such an arrangement and modification of the dues on shipping and goods, &c., as would enable the Commissioners to carry into effect such simple and economical plan as, whilst it improved the town, the navigation, and the harbour generally, would do injury to no one interest or party in particular.

Adverting again to my instructions, I shall now proceed to discuss that part which relates to the proposed loan of 35,000*l.*, viz., that of making a new cut from the quays of Messrs. Dunbar to the Milewater Perch.

One of the professed objects of this cut is, that it will not only be an improvement to the navigation, but that it will form a part of subsequent improvements to the harbour.

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Now, this may or may not be correct, as depending upon what the specific nature of these subsequent improvements may be.

If the subsequent improvements be the carrying into effect that part of Mr. Walker's plan which goes to deepening and dredging along the quays, and making two new cuts from thence to Garmoyle, the proposition holds good, and the cut, as proposed, would certainly form a part of such subsequent improvements. But the question then arises as to whether that part of Mr. Walker's plan which relates to tidal accommodation only (without enclosed docks), and which it is very doubtful whether the present powers of the Commissioners give them the means of accomplishing, be the best means of improving the port; and also, if docks for keeping vessels always afloat be desirable, whether that might not be most satisfactorily and economically carried into effect by converting the present harbour and quays into a dock; and, lastly, whether, in such case, the cut, as proposed to be executed with the loan of 35,000*l.*, would form a part of such subsequent improvements.

In carrying the proposed cut into effect, I have no doubt that it will be found absolutely necessary to dam or stop off the old river-course opposite Dunbar's quays, in order to turn the stream of the river and tide through the new channel: so that this dam (which I do not find included in the estimates) would become necessary in any case; and if the subsequent improvements went no farther than merely making two straight cuts, and deepening in front of the present quays, the measure would truly form a part of the future work: but should it ever be deemed expedient, at any time after the said first cut shall have been completed, to convert the present harbours and quays into a floating dock, the previous execution of the cut will be a hindrance, instead of an advantage, not only as regards the construction of the lock and entrance gates, but also with respect to the trade of the port, which would have to be interrupted during the progress of the works, or the dam and works previously erected would have to be taken down again.

Under these circumstances, it is well worth the serious consideration of all parties concerned in the interest and accommodation of the port, as to whether or not the proposed plan of mortgaging the revenues of the harbour for the making this single cut, which, when completed, will still leave it problematical whether the additional dues depending upon a given depth of water stated in the Act, will become available, and thus, perhaps, preclude future improvements; or whether, taking it for granted that the proposed measure is as much short of what the port really wants, as the plans of Messrs. Rennie and Telford were beyond its means; it would not be better to pursue some medium course, which would meet the wishes or obviate the objections of all parties, and come within such a moderate expenditure, as the advantages to be gained would more than counterbalance the outlay for their attainment.

With this view of the case, I have prepared two plans for the improvement of the port; both of which comprise the general objects of converting the present harbour and quays into a floating dock; making a separate drainage for the town into the tide-way, and adopting so much of Mr. Walker's plan as is comprised in the two river-cuts to Garmoyle

The only difference in the two plans is, that in No. 1 it is proposed to cut a fresh channel for the river through Ballymacarret, supply the docks by a feeder from the river above, and take the drainage of the town into the tide-way both northwards and southwards, as is fully shown and described in the plan.

The other plan, No. 2, goes to damming up the whole river, as far as the first lock on the Lagan, and taking off all the land and flood waters over a very long weir or overfall, extending from Ballymacarret towards the ship lock; and to drain the town by one main sewer, wholly to the northward.

Each of these plans has its advantages; and which would really be the best, must depend upon local circumstances. I deem No. 1 to be rather the more perfect, and, at the same time, rather the most expensive; but either would, in my judgment, well answer every purpose for the improvement of the port.

With respect to the probable cost of either of the measures I have proposed, I may state, after a most careful consideration of the subject, that, although I did not go into such a minute survey as would be requisite for planning and putting such works out for execution; yet, from my general knowledge of, and experience in, such matters, combined with the view I have had of the place, and the documents, plans, and estimates which have come under my notice; I have no hesitation in stating, that, in my opinion, the plan No. 1 would not exceed 150,000*l.*, and that the plan No. 2 would not exceed 125,000*l.*

In conclusion, I am of opinion that it will be perfectly safe, as far as security goes, for the Board of Works to advance 35 or 40,000*l.* for the execution of the proposed cut; and that said cut would undoubtedly be an improvement upon the present state of the navigation. Yet, under all the circumstances of the case, I should advise that the Corporation for improving the port of Belfast, do better by going to Parliament for powers to lay on such a reasonable scale of dues to the port as would enable them to give security for a sum sufficient to carry into effect a work of improvement suitable to the trade and importance of the port and harbour of Belfast.

I am, &c.,
W. CUBITT.

To the Commissioners of Public Works.

Plan No. I. for the Improvement of Belfast Harbour, by W. CUBITT, F.R.S., M.R.I.A., &c., *Civil Engineer: London,* 1835.

THE objects of improvement shown in this plan are to straighten and improve the river from Garmoyle Roads, by means of two new cuts, A and B (as shown in the plan of Mr. Walker of 1831), to form the upper end of the cut B into an entrance basin, C, with a single pair of gates, D, 45 feet wide at the lower end, and a ship lock, E, 45 feet wide and 170 feet long, at the upper end; to form the whole extent of the present quays into a floating dock, by means of two dams, F and G; the dam F to serve as a ballast wharf, where it crosses the present channel, being accessible on both sides; and the dam G to be furnished with a barge lock, communicating with the main channel of the river. A new river channel, H, to be cut through Ballymacarret, with a bridge of not less than 200 feet water-way, for the passage of the land, flood, and tide waters. To effect an improved drainage of the town, two main sewers, to be driven as shown by the red lines on the plan, one commencing in High-street, and passing across Waring-street, along James's-street and Corporation-street, terminating in a large cesspool northward of the new reclaimed grounds, with a sluice into the tide-way, below the gates of entrance basin, would effectually drain all the town northward of High-street; the other, commencing in the neighbourhood of William-street, above May's Docks, crossing Chichester-street, and passing down May-street, would discharge into the tide-way by means of a stop-sluice, below the new bridge, just opposite the proposed new river channel, and would most effectually drain all the southern part of the town between High street and the River Blackstaff. By means of the above sewers all discharge of mud and filth into the docks and harbour would be prevented; and the drains of the town could at any time be cleaned at low water, by sluicing water through them from the floating harbour, and all stagnant water and filth entirely done away with. In order to render the above-described plan quite complete, it would be desirable to make an arrangement with the Lagan Navigation Company for bringing that navigation in one level from the first lock into the floating dock, between the dam G and the Long Bridge; by which means the floating dock would always be kept up to the height of spring-tide high-water; and being constantly supplied with clear fresh water, all deposit from the tides, and the variations of level and depth of water in the docks during neap tides, prevented. Should it not be possible or desirable to bring the Lagan Navigation in one level as a supply to the floating dock or harbour, the same thing may be accomplished by means of a small feeder instead, which may be rendered both useful and ornamental in any grounds or demesne through which it may pass, and the inland navigation continued by the natural channel of the river, as at present. By carrying into effect the above-described plan, the greatest possible advantages may be obtained to the town and harbour of Belfast, at the least possible cost, and without alteration or removal

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of any wharfs, quays, docks, or other accustomed places at present in use for trade and shipping, and a depth of 16, 18, or even 20 feet water, kept at all times in front of and along the present quays, which would enable more than double the business to be done at them which can be done at present. Vessels arriving at Garmoyle Roads might come up at any tide, in any number, and enter the entrance basin, without having to take the ground, and be passed into the harbour either altogether or separately, as might be deemed desirable. The town of Belfast would be improved by a more perfect sewage, and the nuisance of the drains discharging into the harbour and docks altogether done away; and the docks and harbour would at all times be filled with clear fresh water from the river above, ready at all times for lockage water, and for occasionally scouring out the town sewers. The total probable expense of carrying the above plan into execution would not exceed 150,000*l.*; which, taking into account the great extent of accommodation, and advantages afforded by vessels lying at all times afloat, together with the saving of all lighterage, and the additional trade that would be induced from the facilities afforded, would, on the whole, most probably prove a gain instead of a loss, as time and present expenses saved would more than compensate for the slight dues requisite for carrying into effect a measure of this kind, which would render Belfast the most perfect shipping port in Ireland.

Plan No. II. for the Improvement of Belfast Harbour, by W. CUBITT, F.R.S., M.R.I.A., &c., *Civil Engineer: London,* 1835.

THE objects of improvement shown by this plan are the same as No. I., and as far as straightening the river by new cuts A and B, between the town and Garmoyle Roads, and forming part of upper cut into an entrance basin, C, the same. But, instead of forming the river in front of the town into an enclosed floating dock, the proposition in this plan is, to dam up the whole of the river above the town to the same level as the Lagan Navigation above the first lock, or to ordinary spring-tide height, by means of the long dam or weir F G; the part F across the old river channel to be formed into a ballast wharf (as described in No. I.); and the remaining length of about 1600 feet to be a waste weir or overflow for taking off all the land and flood waters. By this means the necessity for a new river cut, and a new bridge at Ballymacarret, would be avoided, the expense reduced, and the plan much simplified. In this plan the drainage of the town, and all the low lands north of the River Blackstaff, would be effected by means of one main sewer from south to north, nearly parallel with the river (intersecting all the present drains, which now discharge themselves into the docks and river), and terminating in a large cesspool beyond the reclaimed grounds, with a self-acting sluice into the tide-way, as denoted by a red line in the plan. By communicating the upper end of this main with the river, by means of a draw-sluice, the whole length of the town may be scoured out at any time, as often as may be deemed necessary, at low water, to the manifest improvement of the cleanliness, comfort, and health of the town, which at present, in the neighbourhood of May's Docks, and at the heads of all the other docks, is filthy almost beyond endurance. The probable expense of this plan, which will ensure a deep and direct channel from Garmoyle Roads to the town, convert the harbour in front of the quays, and the river above, into a floating dock, and improve the sewage of Belfast, by conveying all the drainage into the tide-way, nearly a mile below the town, is 125,000*l.*

No. 115.
Smith, on the proposed Embankments in Belfast Lough.

No. 115.

Mr. GEORGE SMITH'S *Report on the proposed Embankments in Belfast Lough.*

GENTLEMEN, *Belfast*, 12*th Dec.* 1844.

I was instructed by a minute of your Board, on the 21st ult., to report on the probable effect the proposed enclosure of the slobs on the N.W. side of the Lough, by the Belfast and Ballymena Railway Company, would have on the present channel of the River Lagan and the lower part of the harbour.

It appears, from the plan furnished to me on the 3rd inst. by Mr. Davison, as solicitor to the Company, that the promoters of the Bill intend to carry an embankment from the northern extremity on the Antrim side of the channel formed in 1841, following very nearly the direction of the second proposed cut shown in Messrs. Walker and Burges's plan, and continuing thence to Garmoyle in one uninterrupted straight line of nearly two miles in length; from Garmoyle it is continued along the edge of the slob forming the western boundary of Whitehouse Roads, until it terminates at or near the old Whitehouse bridge on the Carrickfergus road. This embankment is altogether about 3¼ miles in length, and encloses 2000 acres of mud banks, nearly one-half of the whole quantity contained within the Lough.

It is further proposed to make a catch-water drain or canal close to the turnpike road, extending from the bridge over the Mile-water along the shore to the south end of Mr. Thomson's cut at the old Whitehouse. This drain or canal is intended to intercept all the inland streams between those two points, the water from the streams between Ringan's Point and the Mile-water being turned into the latter, and those to the north of it below Mount Vernon being carried in the contrary direction, and discharged into the Lough near the old Whitehouse. As by this arrangement the principal land streams that at present empty themselves by the Seal and other channels into the River Lagan are proposed to be conveyed by the catch-water drain into the Mile-water, their diversion will not materially affect the present navigation. The 2000 acres of slob proposed to be reclaimed present a more momentous question; for being covered by every tide, a great portion of the earthy matter brought down from the town and the country beyond it is deposited on these slobs, and retained by the sea-grass and marine plants which cover them. The water from three-fourths at least of this slab drains through the Seal Channel into the River Lagan, opposite the head of the island formed by Joy's Channel and the present navigation. The importance of the body of water, which passes through this channel twice every 24 hours, is sufficiently proved by the fact, that it maintains a width of 200 feet, and a depth of 10 to 12 feet, at low water, for a considerable distance from its entrance. A quantity of water capable of maintaining such a channel as this must, it is evident, contribute very largely towards keeping the pool of Garmoyle in its present state, with a depth of 17 to 20 feet at low water; and the withdrawal of it, without some counteracting measure, must have an injurious effect on the river in general, and particularly upon that part immediately below the entrance of the Seal Channel, the maintenance of which has been always very properly considered of vital importance by this Corporation. There are local circumstances, which I need not enter into fully in this Report, that tend to confirm the opinion I have already expressed of the importance of this drainage to the existence, perhaps, of Garmoyle. In the various opinions given in opposition to the plans of Messrs. Walker and Burges, when first adopted by your body, it was generally asserted that giving an increased velocity to the current would have a tendency to form a bar at the mouth of the river. As far as can be judged in the short period which has elapsed since the opening of the first section of the straight channel, no such effect has been produced; but it must be kept in view that the time is too short to enable engineers to determine with certainty what effect has been produced by the change in the course of a river which comparatively deposits so little as the Lagan. In the evidence given in 1831 before a Committee of the House of Commons, I observe it is stated that the west bank had in 40 years risen 2 feet, little more than half an inch per annum. Now, such a gradual change may be going on in some other part of the harbour, though we have no means of detecting it. So far I have endeavoured to divest my Report of any other consideration than what is best for the harbour of Belfast, and it might perhaps be condensed into a few words, that where circumstances are by nature favourable, it must always be dangerous to make great changes, the effects of which cannot be foreseen.

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There is another mode of considering this question, on which I think it my duty to make a few remarks; I mean the position in which your Board is placed with regard to a great public undertaking, on which your decision may have a considerable influence. I have already stated the good effect which I consider is caused by the drainage of the slobs into the navigation. Although I hold this opinion strongly, and am convinced that even were the second cut made to Garmoyle, the two cuts taken together will not, even with the increased velocity which they will give over the present circuitous course, compensate for the loss sustained by the proposed reclamation of the slobs. Yet the navigation of the river would be so much improved by the making the second cut, that it is a question worthy your consideration whether the increased facilities thus given may not compensate for some additional annual expenditure in dredging, should it hereafter be found necessary to resort to this measure.

The Corporation, it is true, have the power at any time of completing this work themselves, the slabs being kept in their present state. It therefore remains for them to decide whether their wish to forward a public improvement, and the lower price at which the Railway Company may agree to make the second cut, are sufficient reasons for agreeing to the measure; under any circumstances the enclosure of the slobs should not be permitted, unless arrangements for forming the second straight cut constitute a part of the scheme.

In conclusion, I beg to remark, as I have referred in my Report to the plan furnished to me by Mr. Davison, that it does not show correctly parts of the harbour referred to Garmoyle, which is well described in your Act as "the present deep water to the eastward of Joy's Channel," is lettered in the plan sent me, "Channel of the River Lagan," while Whitehouse Roads is lettered "Garmoyle."

I am, &c.,
GEORGE SMITH.

To the Corporation for Preserving and Improving the Port and Harbour of Belfast.

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No. 116.
Beechey, on the proposed Enclosure in Belfast Lough.

Report on the proposed Enclosure in Belfast Lough, by Captain BEECHEY, *R.N. and F.R.S.*

SIR, *H. M. Ship* Firefly, *Pembroke, December 28th*, 1844.

In reply to your inquiry respecting the enclosure of the slob on the Antrim side of the channel to Belfast by an embankment, extending in a straight line nearly from the new cut to the north-east angle of the slob near Garmoyle, and thence along the low water line to Whitehouse Creek, I beg to say that I consider such an undertaking would be very beneficial to the navigation from Garmoyle upwards to Belfast, and in all probability would occasion an improvement also in the channel to seaward, especially if the tongue of mud at the north-east angle of the embankment be cleared away in the direction of the wall and close up to it, which I hold to be necessary to the satisfactory completion of your works.

With reference to a supposed injury which might accrue to the navigation of the river above the cut and to the port of Belfast from this work, which is but an extension of Mr. Walker's plan, already decided upon and indeed partly executed, I conceive that it will not occasion any difference whatever; certainly not any that would be detrimental to navigation, for the cut being straight instead of circuitous, the flood must sooner find its way up, and the descent being in a straight line from the Lagan above the bridge to the extremity of the proposed embankment, must be steeper than if that line were circuitous, and the current in consequence stronger. It is necessary only that there be sufficient space to allow the water to attain nearly its maximum and minimum altitudes before the level at the entrance be sensibly altered by the succeeding tide, and if this be secured an increased scouring action must be produced. Now we have ascertained that there is only twelve minutes' difference between the times of high water at the Corporation Dock and Donaghadee; only seven minutes between it (Corporation Dock) and Bangor, and only three minutes between the Dock and Macedon, and that these times have not been altered by the contractions of the old channel into the new cut, so that there can be no fear, I presume, of the water not finding its proper level above the bridge when the contemplated works shall have been executed: at all events, the mere extension of the wall from the outer end of Mr. Walker's second cut "to the proposed limit, as it will only be one side of the channel, cannot in any way affect the rise of water above, and any apprehension of ultimate detriment to the port must be limited to the effect which may be produced by the completion of Mr. Walker's plan. And although I cannot but consider that a very sensible plan, yet if any bad effects should be found to arise from so long a contracted space of the water to flow through, it would at once be obviated by levelling the south bank of the cut, when finished at the present height of the slob, and keeping an entire embankment along the north side of the channel. But I cannot think this will be necessary. There would not, I think, be any chance of the channel filling up when once made by the removal of the south bank, if the work now contemplated be executed, as there will be a strong current created throughout the whole extent of the embankment by the ebb from the slob on the Downshire tending towards it, and uniting with the ebb from the river above; for you will fine that the tendency of the ebb, when unimpeded by banks, is towards the northern shore of the lough.

I would hereby suggest that during the execution of the work a good landing-place sheltered from all winds be made at the north-east extremity of the embankment, for the convenience of the shipping at Garmoyle, and for the pilots, who might indeed have a house there.

When this embankment is completed, it is clear that the channel to Belfast will be navigable at all hours of tide and time, by a harbour light (gas laid on from the town) at the extremity of the north-east angle, which, in connexion with a railroad to Ballymena, must be advantageous to Belfast.

The desire of the Admiralty to avoid all the intervention of railroads between the sea and its strand is most laudable, and ought to be strictly observed in all cases when the rights of the public or interest of parties are affected by it; and especially those of fishermen or seafaring men; and you will probably have observed, that when attempts have been made by the gentry to render it otherwise, by running out jetties, of which you may see the remains at or near Sowwood, they have been abandoned, so that no detriment to the interests of any party can arise from the proposed enclosure, provided proper access to such places as have heretofore had the advantage of creeks leading up to them be afforded by the works in contemplation. It will not be sufficient that the present proprietor be remunerated for the destruction of those creeks; the public have an interest in the accommodation they afford, and they should, as a matter of course, be preserved, which may be affected by means of the drainage canal.

I have now to observe, that in the construction of the embankment, it will be desirable to bring it as near to the north-east elbow of the slob at Garmoyle as the straight line from the embankment at Thomson's Tower will admit of, and that the line drawn upon the plan from this elbow to Whitehouse passes over three and four feet water at low-water springs, and that the pier D will require to be run out half as far again as it is drawn, in order to reach the low water line. I merely mention this in case it might be of any importance to the detail of your Bill.

I am, &c.,
F. W. BEECHEY.

To Captain Beaufort, R.N., F.R.S., Hydrographer.

No. 117.

Walker, on the proposed Embankment of the Slob.

No. 117.

Mr. WALKER's *Report on Belfast Harbour, and the proposed Embankment of the 'Slob' on the Antrim side.*

SIR, *23, Great George-street, Westminster, 6th March,* 1845.

By a Bill to be brought into Parliament this Session, a Joint Stock Company is proposed to be incorporated, with power to form an embankment, which will exclude the water from the whole of the remaining flat or slob on the Antrim side of the river Lagan, below Belfast; and the question proposed for my consideration and report, by the Commissioners for Preserving and Improving the Port and Harbour of Belfast is, whether this operation will be injurious to the important interests intrusted to them.

My correspondence with Mr. Smith, your engineer, my conferences with him in London, the experiments and measurements he has lately made under my direction, and my previous acquaintance with the place, did not supersede the necessity for my ascertaining some facts, and making some observations on the spot, which I did towards the latter end of last month.

I have read Captain Beechey's report to the Admiralty; his letter to Mr. Tennent; Mr. Smith's report to the Harbour Commissioners; and examined the plans and sections deposited for the proposed embankment.

The space to be embanked is stated to be 2500 acres, or about one-half of the whole area on both sides of the river between the lough and the town, and is covered when the tide is in, but uncovered at low water. If the present average spring tide depth over the space to be embanked be taken at six feet, which is supposed not to be in excess, the embankment will exclude 24,200,000 cubic yards of water.

It has been satisfactory to learn that the first cut according to my design for improving the river, which has now been open for upwards of four years, has been attended with all the good effects that were anticipated by its supporters; and no less so to read the favourable opinion Captain Beechey has of the proposed second cut, or completion of the plan, if executed. So far, therefore, there is practically no difference of opinion between Captain Beechey and myself.

There is, however, this very marked difference between my plan and the proposed embanking plan, which appears to have escaped observation, viz.: that my second cut terminates above the Seal Channel, and does not interfere with its outlet, nor exclude any of the water which now passes through it, while the projected embankment does both, not partially, but entirely.

As the tendency of the river water to deposit silt is but small, I consider that, so far as the second cut extends, a well-defined and margined straight line of river is more important than the greater quantity of tidal water in the present circuitous channel, even if both ends of the old channel were closed, which is not necessary. I also think that in the contracted, straight, artificial channel, the land-freshes would form an important auxiliary to the tidal water; indeed I should almost expect that the greatest current in the first cut during a heavy land flood would be at, or a little before low water, when the tide is out, and when the fresh water is almost the only power.* From these considerations, and the disturbing power of the passing steam vessels, I never apprehended the deposit in either of the two cuts to be so great as to be troublesome or expensive. But this opinion does not apply lower down than the end of the second cut, which is above the Seal Channel. All below this, I consider that tidal water must be the important and influential power, and that the receptacle for it should not be unnecessarily diminished. I believe that this is consistent with any plans or recommendations I have ever given on the subject. By an approximating measurement of a great land flood (such as are not of frequent occurrence), the discharge of fresh water from the river is only one twenty-fifth part (four per cent.) of the quantity of sea water which passes in and out twice in twenty-four hours at every spring tide; the former being two, the latter fifty millions of cubic yards in three hours. Now of all the feeders (not perhaps excepting the navigable river itself) to the Roads and to Garmoyle, the Seal Channel is the greatest. Mr. Smith reports that the water to and from three-fourths of the whole of the slob on the north side of the river, that is proposed to be embanked, say nearly two thousand acres, have their passage through it. Its magnitude may be judged of by its requiring, near its junction with the river, a channel two hundred feet wide and twelve feet deep at low water, for its discharge, and with considerable velocity, as the state of the bottom indicates. The size of the navigable river is sensibly increased after it is joined by the Seal Channel. I do not mean to imply that the other streams which fall into the river higher up on the north side are of no importance, but they are small in comparison of the Seal Channel, the effect of which upon the river is so apparent as to make it the best for illustration. As it is, the tide in the roads is slow, but if the volume of water be materially diminished, so will be the velocity of the tide, and, consequently, in the course of time, the navigable channels or entrances to the river.

It is to be noticed that deep water at Garmoyle is not of the same consequence that it was when all heavy ships were obliged to unload there; and also that the depth at Garmoyle is in some places upwards of 20 feet at low water, of which, therefore, some diminution would not be seriously felt: on the other hand, this great depth does not extend over any considerable length or width, and is confined to the elbow or concave side of the channel; but the tendency to a decreased depth, by materially lessening the quantity of tidal water, will not be confined to Garmoyle and the East side of the Middle Bank, but will affect the Whitehouse Roads and the upper end of the Lough generally.

For the above reasons, I think that the tendency of the embankment contemplated by the proposed Company will be practically injurious to the harbour.

I agree with Captain Beechey, that cutting off the projecting tongue on the north-east side of the channel, opposite Garmoyle, would be an improvement, as it would lead the ebbing tide out of Garmoyle towards the Whitehouse Roads, where some increase of depth is desirable, and would ease the sharp turn which the projection causes. The tendency of the tongue may be to grow out again; but this will take a considerable time, as the deposit from the sea as well as from the river-water is small, and the projection may be again reduced by dredging.

The opinion is general, that the slob or flat, particularly near the shore, towards the upper or south end, is gradually silting up; and it is argued that the entire embanking now proposed is therefore of less importance. You pointed out to me on the ground a particular place, towards the upper end of the flat, which you said you remember to have been considerably deeper thirty years since than it now is, and that there the bottom, which is now mud, was then sand. I do not therefore doubt the fact of the above shallowing, and it is generally stated to have been in operation about 40 years. Now, as this is about the time of the formation of Mr. Thomson's embankment, by which a considerable portion of the flat was inclosed, and as the flat was in existence for probably many centuries before, the embanking and the shallowing appear like cause and effect; and there is no doubt that any embanking of a portion of the slob has, by reducing the run of tide, and more particularly the scour or wash of the waves during winds, the effect of allowing a deposit to settle on the portion that remains uninclosed. I do not say that Mr. Thomson's embankment alone has produced the whole of the diminution in the depth which is noticed, because there are others, and there are also encroachments on a smaller scale along the margin of the flat, all of which have the same tendency: collectively they have a considerable effect, and, if allowed or sanctioned to any extent,

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* I have not been enabled to prove this by experiment there.

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what is left outside or uninclosed will, by the gradual diminution in depth over its surface, become of less importance as a receptacle for tidal water.

The whole matter should be seriously looked at, and the present proposal will have been useful, if it be the means of directing the attention of the Commissioners to the subject generally.

Few persons will, I think, doubt, that the entrance to the river and Belfast Lough generally, would be gradually reduced in depth, if the course of the Lagan were confined by embankments on both sides, and these embankments connected with the shore, so as to enclose the whole of the flats on both sides, and to confine the tide to the narrow channel of the river. The tendency of thus cutting off three miles of the estuary over which the tide and the seas now range, would be to reduce their force, and to form a shallow or flat below the proposed embankment, in the upper part of what is now the Lough; through this new formation the Lagan would preserve its channel; and the roads or deep water, at the junction of the river and the estuary, would be moved lower down the Lough. This may be remote, and on a comparison of all the effects may ultimately be good or it may be bad. Five thousand acres of land would be gained, and if the effluvia from a very large surface of mud, uncovered for several hours in each day, be injurious to the health of the inhabitants, the evil (supposing the land to be in future well drained), would be removed by the embanking. These are advantages which might compensate for the cost that would be required to make and maintain as good an entrance to the river as the present is. I do not wish to prejudice the question by giving it a good or bad character, but to state the facts. And when one half of the whole area is proposed to be taken away by one operation, it is proper to look at the ultimate consequences when they are so important, for the half area that is left will not, it must be observed. produce nearly half the present effect upon the channel, the areas and their scouring effects being in different proportions.

It should also be kept in view that if the whole of the Antrim side is to be inclosed by the authority of Parliament, the owners of the Downshire side would be likely to make a similar application, and to use the same arguments in support of their claim. So far as I can see they would be applicable.

Should the above considerations induce the Commissioners to object to the present embanking measure, the Belfast and Ballymena Railway may, under the deposited plans, be carried near to the shore, so as to be independent of the embanking scheme, and to interfere but little with the waterway; indeed, as the causeway for the railroad must be raised above the surface so as to be quite clear of the tide and the waves, it would prevent the future encroachments of others beyond it, and might thus be useful.

I am, Sir,
Your most obedient servant,
JAMES WALKER.

To Edmund Getty, Esq., Clerk to the Commissioners for Preserving and Improving the Harbour of Belfast.

No. 118.

No. 118. Walker, on the proposed Enclosure in Belfast Lough.

Second Report by JAMES WALKER, Esq., F.R.S., *on the proposed Enclosure in Belfast Lough.*

Great George Street, 17th March, 1845.

SIR,

I have perused and considered Captain Beechey's Report on the proposed scheme for embanking the flat or slob on the Antrim side of the river Lagan below Belfast, and have lately surveyed the place.

Captain Beechey considers that the effect of the embankment would be highly beneficial to the navigation from Garmoyle to Belfast, and that it would, in all probability, occasion an improvement throughout to Whitehouse Roads.

My opinion, so far down as the lower end of the second cut proposed by me in 1837, for the improvement of the port, does not materially differ from that of Captain Beechey's; but I think that the proposed embankment would be injurious to the river navigation below my second cut, and downwards to the entrances to the river and to the roads, extending also to the upper portion of Belfast Lough

I consider that the sectional area or width and depth of the channel, are in a great measure the effect of the tidal currents and the waves, both of which would be lessened by taking off 2500 acres, or about one-half of the whole area on both sides of the river, between the Lough and the town, that is covered to the depth of 6 feet at an average spring tide, but uncovered at low water.

The opinion that the tides and waves, and not the land waters, produce the present section, appears to be strengthened by the fact, that the discharge of fresh water from the river in three hours, after great rains, is not more than 1-25th part of the quantity of sea water, which, in the same time, passes in and out at every spring tide.

I cannot, therefore, recommend that half the above, or twelve times the river water, be allowed to be taken away without any measure for counteracting the practical evil which the abstraction would produce.

I consider that the enclosures which were made by Mr. Thomson and others some 40 years ago, have been injurious, and that any further encroachments upon the tide-way should be prevented. Some notion of allowing individuals to embank the portion of the slob or flat opposite the proposed second cut when made, appears to have been entertained (not I hope agreed to) by the Harbour Commissioners. I have informed them my opinion of the injurious consequences of this, and if my opinion be correct, I trust that the enclosure will be prevented, if the notice of the intention to make it should ever be given to you, as required by the general Act.

Having been applied to by the Harbour Commissioners of Belfast to report my opinion on the measure now before Parliament, I have done so after a visit to the place, and I take leave to annex a copy of the Report, which will be found in unison with the above opinion, and to contain some details which I have thought unnecessary to report.

I have the honour to be, &c. &c.,
(Signed) J. WALKER.

To the Secretary of the Admiralty.

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No. 119. Rendel, on the proposed Enclosure in Belfast Lough.

Report by JAMES M. RENDEL, Esq., F.R.S., *on the proposed Enclosure in Belfast Lough.*

6, *Great George Street, Westminster,*
20th May, 1845.

SIR,

The instructions of the Lords Commissioners of the Admiralty, communicated in your letter of the 10th inst., were, that in reporting to their Lordships the result of my examination of the several plans and papers then and previously transmitted to me, relative to the proposed embankment of the slob-land forming the north shore of Belfast Lough, I should consider the subject only as it bears upon the navigation of that important port, and on the fair interests of those engaged in maritime affairs.

I consider this a very different case from the embankment of mud lands on the shores of an ordinary estuary, by which I mean such as have threatening sand-banks, and distorted entrance channels with shallows, forming bars, which the land-water discharged by the rivers, of which they are the mouths, would be totally incapable of maintaining unaided by the daily flow and ebb of a large body of tidal water.

According to Captain Beechey's most elaborate and admirable chart, completed so recently as 1841, the Lough measures seven miles wide at its mouth, with a depth of 20 feet close up to the south shore,

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Rendel, on the proposed Enclosure in Belfast Lough.

quickly increasing to 40, and becoming from 60 to 70 as it approaches the north shore. It appears that from its mouth to the slobs in question, a distance of 12 miles, the soundings very uniformly decrease, and retain their depth well up to each shore; that both sounding and shores indicate all the characteristics of a bay, deep and capacious from original formation, and the comparative absence of tidal or river deposits, and not made or kept so from the scour of its tidal or any land water.

At the head of this bay is the slob in question, forming the west shore of a channel, through which the River Lagan empties itself into the bay at low-water, and which forms the navigable channel up to the town of Belfast, a distance of about two miles and a half.

This channel is tortuous, irregular in depth, and consequently bad for navigation; and the discharge of the land and such tidal water as passes to and from the upper reaches of the river (above Belfast Bridge) has less power to act as a scour for its maintenance. Under the advice of Mr. Walker, the Harbour Commissioners have recently straightened, narrowed, and embanked this channel for nearly a mile below Belfast Bridge, or about half the length of the slob proposed to be embanked (on the opposite shore), with the best possible results. Mr. Walker's plan, of which the works referred to are only a portion, included the straightening of other bends in the channel; and it is admitted by all parties that, judging from the good results of the work already done, it is most desirable that the whole plan of straightening should be carried out.

It is a conviction upon my mind, that to *permanently secure* a straight channel, it must be, to some extent at least, retained within banks more or less artificial; and that the more these banks are raised, until as high as high-water spring tides, the better the channel will become; in other words, that any scour which the channel now, or when embanked, can permanently derive from such portion of the tidal water covering the slobs as may happen to be brought into it by the branch creeks, is of little or any importance, compared with the good that would result from having banks that should fix the limits of the stream for the whole period of the tide, and concentrate upon the navigable channel all the agitation which is found to result from the use of it by shipping of all kinds, but steamers especially. It appears beyond question, from Captain Beechey's observations, that the tide would rise equally high, if *not higher*, at Belfast, and above the bridge, by confining it within a properly formed channel through the slobs in question. A slight increase of rise of tide in a port with so little flow is of great value to the navigation, and in connexion with the better form of a channel for its passage, would be a most valuable addition to the scour of its bed.

But the great benefit from the straightening and confining the channel within due limits would be derived during land-floods and tides of unusual height. At present the influence of such occurrences is in a considerable degree lost from the great expanse which the waters find when past the straight and embanked channel so lately provided for them. The continuance of similar works to the extent of the slobs would, I am convinced, be attended with the same beneficial results, and that without causing damage or injurious alteration of any kind to the Whitehouse Roads, or any more remote portion of the Lough. But the plans under consideration propose the embankment of the slob on the west side of the channel only. This I think very undesirable. The line proposed for it, as also its extent, seems to me very suitable for continuing the channel in the direction of Mr. Walker's "new cut" by the extension of the line of his embankment to the "west bank."

If parties can be found who will undertake to embank *both* sides of the channel by well formed and permanent stone-faced dykes, giving such width of channel between as upon full inquiry shall be found the best for all purposes of navigation, and quantity of water to be discharged, also undertaking that the dykes on each side shall be extended uniformly with each other, completed before the return to banks reclaim the slobs are commenced, and that the channel be formed by dredging in advance of the dykes, then I am decidedly of opinion that the navigation up to Belfast will be greatly improved, and have a permanence given to it which does not belong to its present character now, but an open channel with loose shifting banks.

I am also of opinion that the effect of such embanking is more calculated to benefit than to injure the "Whitehouse Roads" and the adjoining parts of the Lough.

I however beg to repeat, that the conditions attached to the approval of their Lordships would be such as to insure the carrying out of the stipulations already mentioned.

I have, &c.,
JAS. M. RENDEL.

Captain Hamilton, R.N., Admiralty.

No. 120.

Walker's Third Report on the Embanking the Slob.

No. 120.

Third Report by JAMES WALKER, Esq., F.R.S., *on the Embankment of Belfast Slob.*

23, *Great George-street*, 29th *May*, 1845.

SIR,

Your letter of yesterday's date requests me to inform you if Mr. Rendel's Report, "which the parties interested in the Belfast and Ballymena Railway had requested the Lords Commissioners of the Admiralty to receive," contains anything which leads me to alter the recommendations in my Report of the 17th of March, made by order of their Lordships.

In reply, I beg to say that it does not, and to state shortly my reasons.

There appears to be no difference of opinion between Mr. Rendel and me as to the injury by the Bill now before Parliament, which contemplates the embanking of the west side only of the channel—at least I so understand, Mr. Rendel's expression of that measure being, "very undesirable."

In my Report of the 6th March to the Belfast Harbour Commissioners, I suggested the scheme of embanking both sides. I said that 5000 acres of land would thus be gained, and the evil, if any, from the large surface of mud removed. Also, that these advantages *might* compensate for the cost of making and maintaining as good an entrance to the river as the present is; but I did not, nor do I now see how the *roads*, which are outside the embanked river, are to be benefited; and I still think that, until the whole scheme, and the interests of the public and of parties can be brought fairly and fully forward, it would be imprudent to commit the public, by passing a partial measure, which in itself is agreed to be inadvisable.

I am, &c.,
(Signed) J. WALKER.

Capt. Beaufort, R. N.,
Hydrographer to the Admiralty.

No. 121.

Memorial of the Harbour Corporation.

No. 121.

To the Right Honourable the Lords Commissioners of the Admiralty.

The MEMORIAL of the CORPORATION for Preserving and Improving the Port and Harbour of BELFAST,

Humbly Sheweth—That the said Corporation is a public body, the members of which derive no profit from their services, being appointed under an Act passed in the first year of Her present Majesty's reign the guardians of a harbour the most important in Ireland, both as regards commercial purposes—one-fourth of the trade of that kingdom passing through it—and as regards the safety of shipping taking refuge in bad weather.

That following certain directions contained in the Act referred to, the said Corporation has purchased the existing wharfs, quays, and other property required, at an expense of upwards of one hundred and

APPENDIX B.

BELFAST.

No. 121.
Memorial of the Harbour Corporation.

thirty thousand pounds, and expended in the formation of a new channel with deep water, and in the furtherance of other improvements directed to be made, nearly fifty thousand pounds.

That a much larger sum must still be laid out in improvements to meet the demand for quay and dock accommodation, caused by the facilities now given of reaching the town, and the rapidly increasing trade of this important port.

That the Corporation, under the powers of the Act referred to, have borrowed on the credit of the harbour, from private individuals, a sum of nearly one hundred and fifty thousand pounds, and must borrow still further sums for completing works now in progress or of immedite necessity for the accommodation of shipping when arrived at the town.

That the good effects of the improvements already made by the Corporation since the year 1839, are best shown by the fact that the tonnage frequenting the port for purposes of trade (exclusive of a great amount of vessels coming in from stress of weather, which pay no dues), has increased during the five years which have since elapsed from 354,542 tons to 445,537 tons—equal to the tonnage of Liverpool in 1812—82,499 tons of this increase being on the last year, during which the Corporation has been enabled to make extensive reductions on the dues levied. Vessels, also, which from want of water formerly discharged at a natural basin called Garmoyle, some miles from the town, now come up on a draught of 18 feet, by which not only additional security is afforded to the revenue of Her Majesty's Customs, but vessels reach the quays which a few years ago were almost precluded from trading to Belfast by the heavy charges of lighterage on their cargoes.

That two Bills have been lately introduced into Parliament—one for the purpose of embanking and reclaiming nearly 2500 acres of mud banks now covered by the tidal waters; the other for forming a Railway from Belfast to Ballymena across the mud banks just mentioned.

That Memorialists have been informed by the engineers under whose able instructions its improvement has been hitherto conducted, to the entire satisfaction of the Corporation and the public, that the tendency of the enclosure referred to will be practically to injure the harbour.

That under these circumstances the Corporation have felt it their duty to lay before your Right Honourable Board, in whom the protection of the harbours of these countries is vested, the above statements, feeling as they do great alarm at any attempt to reclaim the land in question, and wishing, while ready to aid all public improvements, that the projectors of the Railway should be confined to such a line as may meet the approbation of the harbour engineers.

Memorialists therefore humbly pray your Lordships that inquiry may be made into the matters hereinbefore contained, and that such measures as to your Lordships may seem meet may be adopted for averting the evils apprehended by your Memorialists, and as in duty bound

Ballast Office, Belfast, 15*th April*, 1845. Memorialists will ever pray.

L.S.

No. 122.
Mr. Steen's Statement of Proceedings.

No. 122.

Statement by J. STEEN, Esq., *of the proceedings of the Corporation for preserving and improving the Port and Harbour of Belfast.*

Ballast Office, Belfast, 13*th Nov.*, 1845.

SIR,

At the recent inquiry before the Tidal Commission in this town, some of the parties examined expressed an opinion that the Corporation for preserving and improving the port and harbour had not used due diligence in execution of the works prescribed—that from the funds at their disposal a greater accommodation of quay-room and otherwise should have been provided—and, finally, that the taxation was heavy and unequally charged, particularly regarding steamers.

Believing that blame does not justly attach to them on any of these grounds, the Corporation request to place before you a brief statement of their proceedings since it was finally determined to adopt the plans suggested by Mr. Walker—to carry out which an Act was obtained 30th June, 1837, 1st Victoria. cap. 76. giving powers for five years to take lands, &c., deemed requisite for the contemplated improvements, It prescribed an order in which the works should be undertaken, authorized an increase of tonnage dues, charges for pilotage and quayage, the imposition of dues on goods which had previously been exempt. It also authorized the borrowing of money, and finally directed the order in which any funds that might arise should be applied.

The work directed to be first undertaken was the first section of the new cut.

The balance in the hands of the Corporation at their preceding audit, 1st of January, 1837, was 5917*l.* 1*s.* 5*d.*, consequently they were unable to execute any important work without recourse to loan.

On the 11th of September, 1837, an application previously made to the Board of Works for the loan of 50,000*l.* was renewed, and after some delay favourably reported upon by that Board; presuming on this, the Corporation on the 25th March, 1838, advertised for contracts for the proposed cut; but on the 25th of April it was announced to them that the Treasury would not sanction the loan. Relying on the favourable disposition of the Board of Works, the Corporation on the 9th of June memorialed the Treasury for a reconsideration of their claim, and finally a loan; but only one of 25,000*l.* was conceded, repayable in twenty years in instalments, with interest at 5 per cent. on condition that the advance should be in sums of 5000*l.*, to be preceded by an outlay to that extent by the Corporation, and so in regard to each successive issue—that the existing property should be mortgaged for the repayment, as also the property they might subsequently acquire, which latter condition they were afterwards called upon to fulfil.

At the audit, 1st of January, 1839, the available fund of the Corporation was only 4437*l.* 18*s.* 3*d.*; therefore to be able to meet the condition of alternate previous outlay of an equal sum, the Corporation was obliged to grant a mortgage for 20,000*l.* to the Belfast Banking Company, which engaged to make advances to that extent as required.

On the 15th of February, 1839, a contract was entered into for the formation of a new cut, to be completed October, 1840.

The Corporation having expended 5000*l.*, the first gale of 5000*l.* was received on the 15th of October, 1839, from the Board of Works; and on the 10th of March, 1840, a second of same amount, the Corporation having as before previously expended an additional 5000*l.*

The Corporation being anxious to carry out the further objects of the Act, the Board of Works was applied to on the 10th of April, 1840, for an increased loan of 185,000*l.*; and on the 10th of July a deputation was sent to solicit the Treasury to grant it; the application was fruitless, as likewise those made to various public companies and individuals for loans.

On the 18th of August, 1840, a third gale of 5000*l.* was drawn from the Board of Works; the previous Exchequer Bills received had been sold at a considerable loss, but the discount had now become so great that the Corporation did not negotiate this last gale.

In December the first gale of repayment was required with interest; and at the same time the Bank (interest being 7 per cent.) required repayment of their advance. The Exchequer Bills bore interest at 3*l.* 0*s.* 10*d.* per cent. per annum, and were quoted at 6 to 7 per cent. discount.

The Corporation, in discharge of the instalment and interest claimed, transmitted 1000*l.* of these unused Exchequer Bills, and the balance 217*l.* 1*s.* 6*d.* in cash. The bills were refused, and payment in cash demanded and made.

Hopeless of progressing further whilst thus situated, their property so encumbered that they could not borrow—without money, consequently unable to appeal in any case to the valuation of a jury, as they had no means to meet a verdict—the Corporation, trusting that the fact that the money they sought to borrow being for the purpose of investing in purchases of real property, would give confidence to lenders, determined to apply to Parliament for an amended Act to give greater confidence in their bonds when issued by annulling the power to borrow from the Treasury, and its consequent precedence, a step which involved

Mr. Steen's Statement of Proceedings.

the necessity of paying off the loan already obtained through the Board of Works, as well as the mortgage to their bankers.

This Act was obtained the 21st of June, 1841, and the Government loan repaid the 21st of September the same year, the Board of Works having consented to receive back in part discharge the still unused 5000*l.* Exchequer Bills, charging, however, 5 per cent. interest thereon from the period of issue.

The Corporation immediately proceeded to treat with the proprietors of the quays on the basis that the sellers should for a certain portion receive bonds in payment, and succeeded in the same month in purchasing those of Mr. Tomb for 40,000*l.*, and Mr. Cunningham's for 6000*l.*, but possession was not obtained till the 12th of September and 10th of October in the following year; a further property at first not considered indispensable was purchased from Mr. Cunningham at 9000*l.*

Treaties were opened with Mr. Dunbar and Mr. Gregg; the former was at first unsuccessful; it was afterwards renewed and finally closed October, 1842, for 46,000*l.*, half bonds half cash.

Mr. Gregg's was agreed for April, 1843, 20,500*l.* In both these cases difficulties as to title arose, and finally the amount was lodged in Court, and possession obtained of both the 16th of July, 1844.

The Corporation being now possessed of all the Antrim quays, adopted on the first of the following month a uniform and very greatly reduced scale of quayage.

The Act of June, 1837, enjoined the purchase and payment of all the Antrim quays previous to any purchase in county Down. The period for compulsory purchase expired June, 1843; consequently an extension of time became necessary, and an Act granting two additional years was obtained the 27th of June, 1843, which also relieved the Corporation from the condition of an order of works. Under this Act the quay of Mr. Batt was purchased November, 1843, for 1500*l.*

The treaty with the other parties interested in the county Down property failing, recourse was had to a jury in January, 1844.

In February, 1844, tenders to erect a quay 2000 feet in length on the property thus acquired were advertised for, and on the 21st of March a contract was concluded for the same with Messrs. Little, of London. It will be ready for pavement on the 1st of May next; the bank being formed of dredgings of the river would not be sufficiently consolidated at an earlier period.

Difficulties having arisen, possession of Mr. Batt's portion was not obtained till May, 1845, which prevented its being commenced at same time; it has been contracted for by the same parties, and is now in progress. This delay, and not the wish of the Corporation, was the cause of not commencing the formation of the quay at the end next the bridge, alluded to as an error by one of the parties giving evidence. This will give 2300 feet of quayage in County Down.

The Corporation is as deeply impressed as any of their townsmen with the insufficiency and many defects of the present quays. The very urgent and very just complaint of the present want of quay-room fully proves that not a single ship's length could be withdrawn from occupation for any effectual or permanent repair until other accommodation for shipping is provided. The foundations are so insufficient, even for the ancient depth of water, that in dredging the greatest caution is requisite, from the risk of their entirely giving way, an event that would involve the total obstruction of the trade. The Corporation feel that there can be no remedy until a substitute be provided, and every exertion in their power has been used to obtain this at the earliest possible period, by the construction of the extensive quay in the County Down mentioned above. This relief is now at hand; the renewal and extension of the Antrim quays in a substantial manner has seriously occupied the attention of the Corporation, and arrangements are made by which the commencement upon them will be simultaneous with the completion of that in the County Down.

During the above period the Corporation has built a vessel for accommodation of the pilots, at a considerable expense, and also erected a harbour light-house, both of great advantage to vessels frequenting the harbour for refuge or trade. No charge is made.

A new entrance to Dunbar's Dock, to cost 3427*l.* 10*s.*, is now in progress.

The foregoing statement will show the difficulties the Corporation experienced in carrying out the objects of the Act of 1837.

If the proprietors of the old quays refused to treat on fair terms, the Corporation could not appeal to a jury, as they had not funds to meet a verdict, which must have been paid in cash. In addition, they were restricted by an order of works enhancing the value of the property they were subsequently to purchase; they were prohibited from applying any funds they might obtain to the forming of any docks or quays on the Antrim side of the river, or doing any act that might prejudicially affect the interests of the then proprietors of the Antrim quays, and finally prohibited from forming any quays or docks in the County Down until those in Antrim were purchased and paid for.

In reference to the annual revenue of the Corporation, the sums borrowed, and their application, the members consider it proper to append the following brief statement.

The revenue, as stated in the return handed in to the Commissioners, here represents the gross amounts received, not the net sum produced by each tax, thus:—

	£.	s.	d.
In 1843, ballast, returned at the gross sum of	2,259	6	6
Only produced, after deducting charges, the net sum of	1,153	16	2
Pilotage, returned at the gross sum of	4,742	4	10
Only produced, after deducting pilots' wages, the net sum of	2,117	9	8
Graving-docks, returned at the gross sum of	684	5	11
Only produced, after deducting expenses and proportion of Capt. M'Ribbin's salary, the net sum of	53	13	3

The same remark applies to *quayage account*, which is subject to heavy taxes, repairs, &c., and to *porterage account*, which is a gross sum, comprising wages, salaries, and several other charges. The pilotage establishment yields no profit; the sum deducted from the pilots' wages being intended merely to suffice for upholding the pilot-boat and light-house. By the change of taxation in 1844, agreeably to a report, a copy of which was handed to the Commissioners, the profit on ballast was further greatly reduced, as was also the charge for quayage, and the profit on pilotage was entirely relinquished.

The great increase which appears in taxation in 1841 is occasioned by the tonnage-dues being in that year raised from 2*d.* to 4*d.*, and a rate, imposed for the first time, on goods imported and exported, with the exception that the tonnage on Irish coasters was in August last reduced to 2*d.* Those charges still remain in force, but a reduction of a nearly equal amount, as is shown by the following calculations, has been made in other taxes.

	£.	s.	d.	£.	s.	d.
The additional tonnage-dues of 2*d.*, imposed in 1841, would, on the trade of 1844—445,537 tons—yield				3712	16	2
In August, 1844, this was remitted on Irish, 7850 tons	65	8	4			
The reduction on charges for ballast, same time	880	11	0			
The reduction on quayage paid by vessels	684	8	0			
Profit on pilotage abolished	2,672	19	8			
Remission, in 1841, of charges attaching to vessels alone	4,303	7	0			
Tax of 2*d.*, imposed in 1841, would have yielded	3,712	16	2			
	£590	10	10			

Appendix B.

Belfast.

No. 120.
Steen's statement of proceedings.

Consequently the taxes attaching to shipping have been actually reduced 590*l.* 10*s.* 10*d.* less than they would have been under the taxation of 1837, previous to any improvements being undertaken or money borrowed, and when the trade was subject to a very heavy amount of lighterage on vessels which could not approach the town.

	£.	*s.*	*d.*
On goods, the rates imposed in 1841, and still continued, yielded in 1844	4,598	6	5
The proportion of quayage attaching to goods was in August, 1844, wholly emitted, being equal to	2,487	12	0
Reducing the increase by new impost to	2,110	14	5
The shipping being relieved as above	590	10	10
Makes the total increase since 1837	1,520	3	7

" While since that period 42,063*l.* 9*s.* 9*d.* has been expended on the first section of the new cut; 132,798*l.* 13*s.* 4*d.* on the purchases of real property, besides a considerable sum on other improvements. The funded debt of the Corporation on the day of the investigation by the Tidal Harbour Commissioner was 153,170*l.*, the interest on which, 7140*l.*, is included in the annual expenditure.

With reference to the relief given to different classes of vessels, steamers, colliers, &c., it may be stated that, by the reduction of pilotage, the former was relieved about 1020*l.*; the latter, equal tonnage, only about 740*l.*

The quayage is charged at the same rate, but colliers lie usually stem on to the quay, while steamers, being berthed with their sides to the quay, occupy for their tonnage a greater extent of quay-room, which compensates for the short stay they make, compared with other coasters.

In reducing the income of the port so much, the Corporation were actuated not only by a desire to relieve the trade, but a strong confidence that it would tend greatly to increase it. The result has so far realized these expectations, and they hope by its continuance to be able to carry out their quay improvements without being obliged to increase their rates. Circumstances, however, affecting the surplus revenue of such a Corporation, and that cannot be foreseen, will occur and occasionally frustrate their expectations. Such a circumstance did arise in the present year, by the Corporation being, under the advice of their engineers, obliged to resist in the last Session of Parliament an attempt to obtain an Act to embank the slobs of the harbour; the opposition was successful, but it cost the Corporation 1031*l.* 0*s.* 6*d.* in so doing.

Signed by order of the Corporation,

James Steen, *Chairman.*

Larne.

No. 121.
Evans on the injury of depositing limestone in the Harbour.

No. 121.

LARNE.

Capt. Evans, *R.N., on the Injury done by the deposit of Limestone in the Harbour.*

Gwydyr House, Whitehall, 29th Jan., 1846.

Sir,

I have the honour to inform you, that I discovered the existence of the following mischievous practices while sounding the harbour of Loch Larne, on the north-east coast of Ireland, in obedience to your orders of the 25th November, 1845.

A number of old vessels are employed to take limestone from Loch Larne to Liverpool and the Lancashire ports.

These vessels load as deep as they can, and get their bill of lading at the quarries three or four miles up the loch. They then drop down to the best anchorage at "Yellow Stone," where, during the night, a quantity of the limestone is thrown overboard to lighten the vessels, thus *injuring the harbour*, and defrauding the owners of the stones, who pay freight, &c., by the bill of lading.

I have, &c.,

Geo. Evans, *Capt., R.N.*

To the Secretary of the Admiralty.

No. 122.
Charlesson, on throwing limestone and ballast over in the Harbour.

No. 122.

Lieutenant Charlesson, *R.N, on throwing Limestone and Ballast over in Larne Harbour.*

" Royal George, R.C.," Carrickfergus,
6th February, 1846.

Sir,

In compliance with your directions, I proceeded to Larne, and questioned several people concerning masters of vessels throwing out part of their cargo of limestone and ballast at the entrance of the harbour and at the Yellow Stone; their answers I beg to forward, viz. :—

Daniel Urell, a pilot, states that he has frequently known during the last 12 months, limestone being thrown overboard at Yellow Stone.

John Davis, who keeps the ferry close to the Yellow Stone, states that he has seen them throw limestone overboard there when loaded too deep coming from Ballylig, and frequently heard them do it during the night.

Alexander Cain and John Smiley (the latter a respectable farmer), close to the ferry, corroborate the above statements, and say it was quite a common occurrence two summers since, for the masters of vessels to throw their ballast overboard at the entrance of the harbour.

I am, &c.,

B. W. Charlesson, *Lieutenant R.N., Commander.*

Inspecting-Commander Bowie,
Carrickfergus.

APPENDIX B.

ARDGLASS.

No. 123.

Evidence taken on the 3rd Oct., 1845.

No. 123.

PORT OF ARDGLASS.

Examining Commissioner—Captain WASHINGTON, R.N. and F.R.S,

Present—Major BEAUCLERK, Captain SAUNDERS, Captain BROWNE, Captain DESPARD, Lieutenant BLIGH, R.N., Mr. CURRAN, Mr. PILSON, Mr. FRAZER, C.E., &c.

[*A model of the quay, before its partial destruction, was exhibited in the room. The copy of a chart of the harbour, drawn by Mr. Roberts, under the direction of John Frazer, Esq, County Surveyor, was placed on a table.*]

Mr. FRAZER pointed out certain proposed alterations, some of which were to take away the new quay, to blast the rocks in the harbour which caused the sea to rebound, and give the sea a greater sweep, instead of confining it by a wall.

Major BEAUCLERK would give up his garden if necessary, for that purpose; and he had offered 8000*l.* for the outer work, if government would make it a refuge harbour, and do the inner part.

Captain MICHAEL COTTER examined.—Is twenty years acquainted with Ardglass harbour as the master of a vessel; was in the habit of running into it in the *Eliza*, a brig of 125 tons. There was no difficulty in taking harbour when the wind was southerly; never took it in a gale of wind, but knew others to do so; could not beach his vessel in the present state of the harbour; a vessel lay quiet after she was in; heard that one had broken adrift, but it was likely from insufficient moorings. The holding-ground was good, being sand mixed with clay, close to the pier-head. Saw twelve vessels lying at a time in the harbour; saw larger ones than his own; saw steamers there. If the rocks were taken away it would make a good safety harbour. If the proposed alterations were made, the harbour would answer the purpose intended. If docks were made, traffic would increase. Several wrecks had occurred on the coast, both when the wind was north and when it was south. Saw several vessels in jeopardy, and if the proposed alterations had been made, they would have run into Ardglass harbour and have been safe.

Mr. WARING CURRAN stated that a government packet, the *Jemima*, about twenty years ago, bound from London to Dublin, with important documents, made into Ardglass, in stress of weather, when she could make to no other port. Saw thirty large vessels enter the harbour in a heavy gale since the new quay was built.

WILLIAM CONVERY, pilot, examined.—Is twenty years at Ardglass, has seen fifteen large vessels in the harbour. Saw vessels taking the harbour in a gale, the wind blowing E.N.E. There is no heavy sea in the harbour; never saw a ship break her anchors in it; one did from bad management. The same night eleven did not break theirs. The rocks were the chief difficulty in coming into the harbour; the holding ground was good. The vessel he piloted rode in safety with a thirty fathom cable, inside the Perch-rock. A beach is much wanted for the sea to expend itself on. The docks would do great good to the harbour. A vessel was never lost coming into the harbour, from the swell. The sea seldom breaks into the harbour.

Captain WHEELER examined.—Has been trading between Maryport and Ardglass twenty years. Took the port of Ardglass in heavy weather without difficulty. It is easier to take than Maryport; with a free wind, there is room to fetch and bring up in the harbour. When the wind is N.E. the harbour is sheltered. Vessels 110 tons burthen never broke adrift; has come in, in stress of weather, for shelter, when coming from Scotland to Dublin. Dundrum Bay, before the light-house was erected on St. John's Point, was the worst place on the coast for wrecks; when some vessels were lost at Strangford and other places, one took Ardglass, and was saved.

A sailor, who had been in the vessel alluded to, said that she had been bound for Liverpool, and, in a heavy gale from S.E., ran to Ardglass and took harbour, after dark; there was no place on the coast to save their lives else; all were saved and the cargo too. They could not have taken Strangford from the strong tide and no lights. This occurred in October, 1844; four or five vessels were lost on the coast that night. The vessel he was in had neither chain nor anchor.

Major BEAUCLERK.—The immense loss of vessels on the coast shows the want of some harbour of refuge, and if the government can get a better than Ardglass let them take it.

The COMMISSIONER had a printed return which showed that sixty-three wrecks had taken place in Dundrum Bay within sixty-three years, six of them in 1838.

Mr. B. HUGHES, harbour-master, said that 327 vessels came into the harbour while the pier was standing, viz., from 1837 to 1838, 69 of which were fishing vessels.

Lieut. BLIGH, coast guard service, examined.—Is stationed at Ardglass ten months. Saw vessels riding in the harbour in a gale in safety; one of his crew, as a pilot, brought in a brig of 153 tons. A safety harbour was much wanted on the coast, and it was desirable that Ardglass be made one. There would be no difficulty in carrying on the works proposed; the harbour had a good mouth; the sea break arose from the confined entrance and the rebound of the rocks; the break would not sweep a ship's decks; room was most wanted when a vessel came in. With judicious outlay of money, it might be made a good harbour of refuge—a beaching-place would be a great improvement. Had sometimes seen sixty sail of vessels passing at once. Registered six or eight first-class vessels or yawls; the fishing vessels came from Arklow, Cornwall, Isle of Man, &c.; saw three hundred fishing vessels at once in the harbour. They had no other harbour to lie afloat in, and Ardglass was the best market.

Major BEAUCLERK said that a great argument for improving the harbour was to be found in the fact, that after the Great County Down Railway would be made, with a branch to Ardglass, there would be steamers trading to it, and the tolls would pay the interest of the money expended on it.

Mr. JOHN FRASER stated the several lines of railway which were contemplated in the county, and said there would be a branch from Downpatrick to Ardglass. Then it was expected that the trade of the North of England to Belfast would come by Ardglass, through Downpatrick, as the distance was thirty miles shorter. The mails would also probably be carried the same way, as it was important to save sea-voyage, a great object with engineers, and letters would reach several parts of Ireland many hours sooner. If the harbour at Ardglass were improved, the fertile barony of Lecale and part of Kinalarty would export that way corn, potatoes, cattle, &c. and import coals, and the country would be greatly accommodated. There were quarries for the rough work at hand, and

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Evidence taken on the 3rd Oct., 1845.

limestone could be procured from the Isle of Man for facing; there would be no great difficulty or expense in carrying out the proposed improvements. The old stones might be fished up, and some new ones would be wanted. Mr. Rastrick (chief engineer for the Great County Down Railway) and he had examined the harbour, and the former was of opinion that it could be made a good harbour at moderate expense, and that the railway should communicate with it.

JOHN LEMONT, pilot, examined.—His testimony was, for the most part, the same in substance as that given by other pilots and seamen. Ardglass was the great refuge harbour for the herring-fishing. There were 200 sail at a time of herring-fishing vessels.

Captain SAUNDERS said that the fishing boats had amounted to 400 or 500, till those under fifteen tons were excluded from receiving bounty. A Cornwall fisherman told him that he had earned 100*l*. in one season.

Mr. CONWAY PILSON stated, that he was an inhabitant of Downpatrick, the assize town of the county of Down, distant six miles from Ardglass, and containing about five thousand inhabitants, who were distinguished for their industry and wealth; that a considerable retail trade was carried on in it. The majority of its merchants imported their goods direct from England, and for want of better communication with Liverpool, they were obliged to bring these goods by Belfast, and pay a land carriage of eighteen miles, at the rate of 10d. per cwt. If Ardglass were made a secure harbour, no doubt first-class steamers would be placed on the station between it and Liverpool; and from the shortness of the sea, as well as the advantage of entering this harbour at all times of tide, freights would be much lower than to Belfast, and the land carriage being only six miles, the expense would not exceed the third of that from Belfast. This would be a considerable saving to the public —the consumer deriving the benefit, as the various commodities could be sold so much cheaper. He estimated the goods carted in this way from Belfast at thirty tons weekly. The passenger traffic and exports of agricultural produce by Ardglass would also be very considerable; the quantity of corn, cattle, pork, butter, poultry, and eggs exported from this county to England was very large indeed, and as there was a railway in contemplation through the county, with a branch to communicate with Ardglass, the passenger traffic alone to and from England by this route would be very considerable. He had heard gentlemen who live within a few miles of Belfast say, that if on the completion of the railway to Ardglass, a first-class steamer would ply between that place and Liverpool, they would take that route to England for the shortness of the sea; and he had no doubt that this feeling would prevail generally, and that persons would come from a great distance in the interior of the country to go to England by Ardglass, owing to the shortness of the sea. The promoters of the line, comprising almost all the landed proprietors and merchants of the county, have matters in a very forward state. Their acting engineer has the surveys completed, and from all he could learn, he had no doubt a bill would be obtained during the ensuing session of parliament for this very desirable railway.

Captain DESPARD asked a pilot, before examined, if he could beat out of Ardglass as well as Killough, and the latter said he could.

Mr. B. HUGHES said that two vessels were lost in Kingstown harbour, and the same night none were lost at Ardglass.

Mr. WILLIAM FRASER, C.E.—Has frequently seen the harbour of Ardglass; examined it again to-day; conceives that it possesses facilities for being converted into a good safety harbour; there are no peculiar difficulties in the way of construction that cannot be overcome at a moderate expense, particularly as all the former work, below the level of low water, is still in existence, requiring nothing but the superstructure to be made. Were this not the case, the cost would be very considerable, as much bell-work would then be required. If all were to be constructed anew, he would propose a change in the direction of the pier; would also propose the excavation of all the rocks inside the harbour, and the clearing away of the pier and peninsula where the new dock is now being made—would beach all this portion of the shore, and construct the docks at the extremity of the harbour. Conceives a square pier-head could be constructed more easily and strongly than a round one.

No. 124.

No. 124.
Nimmo, on the Harbour.

Mr. ALEX. NIMMO, *on the Harbour of Ardglass.*

1822.

ARDGLASS is a small rocky bay or creek, about 150 fathoms wide, and extending at high water 500 fathoms inland, with three or four sandy coves along its shores, divided from each other by rocky ledges. Of these ledges the outer one on the west side has been built up at public expense into a kind of pier, so as to cover the adjoining coves of 70 fathoms by 130 at high water, which is properly the harbour of Ardglass. It is provided with a light at the extremity, and as this place has always 3 or 4 fathoms at the entrance, it may be run for at night, and especially at low water, which is a great convenience on this coast. There is a stone perch on the end of the adjoining ledge on the west side. The remainder of the bay is yet in its original state; but in the innermost cove, called "Kimmer's Post," which is dry at low water, small vessels may be safe from all winds and sea.

Ardglass is extensively engaged in the fishery. It is the place of rendezvous for the herring fishery, and for haddock, cod, &c., for the supply of the country markets.

It is to be regretted that, after all the money which has been expended upon the harbour, it is still far from answering expectation.

When south-east winds set in, which are the most violent on this coast, the deep water being near, a heavy ground-swell runs into Ardglass, and being brought up in a short space by the ledge of the perch rock, is deflected into the cove forming the present harbour; which being so much bounded by wall and steep rock, becomes excessively turbulent; the craft thump much on the bottom, and can with difficulty hold on with all their tackle; nor is there any means of escaping at such times into any of the other coves of the bay, so that vessels are often seriously damaged.

This violent run might have been foreseen at the first construction of the harbour, and should have been prevented, if possible; and it was perhaps with a view to this that the pier was originally designed to be carried beyond the rock, and a considerable way into deep water, with a jetty near the head. This would certainly have been attended with a great expense. I have some doubt whether it would have the desired effect, and it would probably increase the difficulty of turning into or out of

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the harbour. Unfortunately, however, instead of this termination, the head of the pier is now forme with a hollow curve on the inside, which is of no use as a wharf for ships, and seems to increase the evil complained of.

My advice would be to cut a passage across the rocky ledge, which separates the present from the middle harbour, as far as the opening behind Maggy's Rock, all of which is accessible at low water, and build with this a breakwater, on the outer and broader part of the ledge behind the perch. The run having then room to pass away into the middle harbour, and out at its present entrance, would be vastly diminished near the present pier; and vessels which be uneasy there might pass away into the middle harbour when the tide made, and lie behind the breakwater aforesaid, or even go on to Kimmer's Post. Again, vessels coming in with too much way to luff up clear of the Perch Rock, might go on, enter by the middle harbour, and bring up to the pier by the new passage.

I consider the present jetty to be of no use, as the run comes to it from the inside; but a similar jetty on the opposite side might be of some service, or rather the facing up of the rock forming the side of the proposed passage, and by quaying the ledges of the middle harbour, safer and more convenient wharfs would be got than any yet constructed.

It is evident that this is a work which may be done by degrees; in all future operations at Ardglass it should be kept in view. The excavations at Bangor Harbour in Belfast Lough, have already removed four times as much rock as I now propose, and all this at the expense of a private individual.

ALEX. NIMMO.

No. 125.
Vignolles, on the state of the Works.

No. 125.

Report by Mr. VIGNOLLES *on the State of the Works of Ardglass Harbour and Pier.*

SIR,

Dublin, 12*th January*, 1839.

I have had the honour of receiving the letter from the Board, under date of the 30th November last requesting me to report upon the pier at Ardglass Harbour, on the east coast of Ireland, in the county of Down.

Before proceeding to give a formal report and opinion on the works at this harbour, having had occasion, for my own information and satisfaction, to abstract from the various documents transmitted to me a brief history of the present course of events, it may not be altogether irrelevant to narrate them very briefly for the sake of reference.

The present pier at Ardglass was commenced in the year 1829-30, by the late Mr. Ogilvie, the owner of that small town and of the circumjacent property. The improvements consisted mainly in an extension of the old pier into deeper water, and were designed by and carried on under the direction of Sir John Rennie, with the professed object of forming an asylum harbour and a commercial port, affording a great depth of water at the lowest ebb of spring tides, besides offering advantages to the fishery boats, revenue cutters, and for various public purposes. The original estimate was 16,886*l*., but owing to some damage sustained in the course of the construction of the pier, and of an additional extension of 21 feet further into deep water than intended by the first design, the cost was estimated in February, 1832, as likely to amount to 20,000*l*.

The first outlay was made by Mr. Ogilvie, who obtained an Act of Parliament, vesting the pier and harbour in a body of Commissioners, consisting of himself, his agents, &c., with powers to levy tolls, &c., and Mr. Ogilvie continued to advance funds to the amount of from 13,000*l*. to 14,000*l*., for which the Harbour Commissioners gave debentures to Major Beauclerk, the nephew and intended heir of Mr. Ogilvie.

In the spring of 1832, Sir John Rennie reported on the progress made in the construction of the pier, and estimated the amount necessary for its completion at 6,650*l*., including the additional length of 21 feet above mentioned.

On this report, the Commissioners of Ardglass Harbour applied to the Board of Public Works for a loan, which was granted to the above amount, or nearly so, after certain inquiries, and a letter from Sir John Rennie to the Chairman of the Board, stating his opinion that the great probability of returns offered an ample guarantee for the repayment of the amount necessary to complete the pier, according to his (Sir John's) estimate.

The works appear to have been pushed on vigorously in the summer of 1832, by the aid of this loan, under the inspection of the assistant of Sir John Rennie, Mr. David Logan, who certified an expenditure of 4,189*l*. up to the 26th July, and on the 8th September, reported that the greatest exertions had been making, up to that date, to complete the works, the state of which he describes.

In the latter end of September, 1832, by order of the Board of Public Works, Mr. Hamilton H. Killaly reported on the pier, and estimated the value of the works remaining to be executed at 2,150*l*.; but Mr. Killaly represented that it would be best to economise in the mode of constructing the parapet, the saving on which would clear from the inner side of the pier the rubble material, which the gales of preceding winters had washed from the sea slope, or glacis, to inside the harbour.

By the middle of December, 1832, the pier was closed, but by this time the funds were exhausted, leaving the parapet, coping, and paving, in an unfinished state; and in March, 1833, after an inspection of the works, Sir John Rennie estimated the cost of completing the parapet, and giving further security to the foot of the sea slope or glacis, and grouting and pointing the whole pavement, and removing the rubble which successive gales had washed from the glacis, and lodged inside the quay wall, at the sum of 4,098*l*., but at the same time stating that his former estimate of 6,650*l*. would have amply sufficed, if the pier had not been extended 52 feet, by order of the Commissioners, thereby causing an increase of 4,680*l*., but which, from the increased tranquillity and accommodation in the harbour, Sir John Rennie considered as most judiciously expended.

The Harbour Commissioners being without funds, applied again to the Board of Public Works for a further loan of the above sum of 4,098*l*. Mr. Ogilvie had died in the course of the preceding year, having, as alleged by the Harbour Commissioners, expended altogether the sum of 16,700*l*., though it does not appear in what manner the additional 3,000*l*. beyond his previous advances were laid out. Major Beauclerk succeeded to the Ardglass property of his grandfather, but perhaps without the same means of supplying money for the pier. It would appear, that some difference of opinion existed as to the extension of the pier, the whole addition to which was not included in Sir John Rennie's estimate of 6,650*l*. The Board of Works, however, were not disposed to sanction any further loan, on grounds fully stated at the time.

Mr. Killaly having been called upon by the Commissioners for explanations of his statements in the September preceding, repeated his conviction in a report dated April, 1833, that the works might have been finished substantially for his then estimate of 2,150*l*., and attributing the want of money to the execution of works not contemplated by him to be necessary, and to the probability of unpaid debts existing, of which he had no cognizance, &c.: and Mr. Killaly remarked on the last estimate of Sir John Rennie, as containing various additional items not included by him, particularly the clearing of the rubble stone from the harbour, the expense of which Mr. Killaly would have provided for by a more economical construction of the parapet. Matters seem to have remained in this state for five years, but in the interval the Ballast Corporation of Dublin determined on building a new lighthouse on the Ardglass Pier. The reasons for this do not appear: although it is evident from a former report of Sir John Rennie, that a light on the

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pier would be hidden by the adjoining headlands, and it was by him recommended that a new lighthouse should rather be built on one of the heads, where it would effectually indicate the entrance to Ardglass Harbour, and enable vessels to clear Dundrum Bay. It should be remarked that between the end of July, 1832 (when Mr. Logan certified that 4,189*l.* had been expended of the loan of 6,500*l.*), and the end of September of the same year (when Mr. Killaly reported that work to the value of 2,150*l.* remained to be executed), occurred the most favourable season for work, which appeared to have been fully taken advantage of, and the operations carried on day and night; and looking to the quantity of work performed between the 1st May and the 26th July, it is probable that nearly as much more must have been executed at the period of Mr. Killaly's inspection, and it is singular that the fact of the value of the whole loan, if not actually paid at the moment in money, having been already expended in labour and materials on the works at that period, was not brought to the notice of the Commissioners. Probably Mr. Killaly had nothing before him to enable him to find this out, and according to instructions only looked at what remained to be done.

In the spring of 1838, Major Beauclerk appears to have forcibly urged on the Board of Works, to recommend the Treasury to take the pier and harbour entirely off his hand, offering to give the whole up to Government, and to forego all his claims for the debentures issued to meet the advances of the late Mr. Ogilvie, provided the repairs of the damages incurred by the pier, during the preceding winter, were made at the public expense, so as to preserve the work from the probable destruction by future storms, a calamity which appeared inevitable, if some immediate and effectual repairs were not then made. The spring passed away in correspondence, and it was not till the beginning of June that the Board of Works obtained the orders from the Treasury, to procure a detailed report and estimate on the cost of the repairs, and on the probable income from port dues.

On the 8th of June, particular instructions were written out for Mr. Gibbons, the engineer of Kingstown Harbour, with orders to proceed to inspect and report on Ardglass; a duty immediately attended to by Mr. Gibbons, who made a strict and minute examination of the works, and reported fully on the 30th June, accompanying his report with an estimate amounting to 7,380*l.*, for repairs as essential for the protection of the whole work from utter ruin, besides a further estimate of 1,150*l.*, for clearing the rubble from the basin, and removing some rocks—operations very essential for any considerable extension of trade, by affording the necessary and adequate accommodation for steamers and coasters,—and an additional estimate of from 3,000*l.* to 4,000*l.*, to clear away other rocks, for the purpose of enhancing the value of the port as an asylum harbour: in all amounting to 12,000*l.* or 13,000*l.* The amount of this estimate of 7,000*l.* or 8,000*l.* for necessary repairs, which the Board of Public Works appear to have been given to understand would not have exceeded 700*l.* or 800*l.*, made it necessary to have further opinions; and on the 4th July, written instructions were given to Mr. Owen, the acting engineer of the Board of Public Works, to visit Ardglass, and consider whether a more economical manner of working at the repairs might not be adopted. On the 24th July, Mr. Owen made his report, reducing the estimate of indispensable repair to the sum of 2,194*l.*, besides 1 500*l.* for clearing the rocks and rubble stone from the harbour.

The Board of Works after consideration of these reports communicated with the Treasury, but it was not till the beginning of October that a sanction was given to expend 600*l.* or 700*l.* on the works of Ardglass Harbour, with a view of saving them from immediate destruction. Mr. Owen was ordered, on the 3rd October, to proceed forthwith to Ardglass, which he did, taking with him Mr. Atwood, a superintendent, extremely well experienced in similar works, and made the best arrangements he could, placing the inspection of the proposed repairs by Mr. Atwood under Mr. Frazer, the engineer for the county of Down.

But the whole available season from April to October, had been lost in correspondence and negotiations, the gales from the east had already set in, and material had to be sought for at the Isle of Man, at Donaghadee, and elsewhere, for the exhausted quarries at Ardglass produced only rubble stones, or at all events could not be properly opened again at once; and although great exertions were made by Mr. Atwood during the month of October, but little effectual good could be done for want of heavy material, and on the night of the 6th of November, the stones that had been laid were all displaced by the high tides and heavy S.E gale, the breach was considerably widened, and the ashlar parapet near the lighthouse dangerously fractured. From thence a succession of eastward gales occurred, increasing the damage, and adding to the danger and destruction, until the 27th November, when the lighthouse being undermined, fell into the sea, and the pile was almost wholly broken down.

Such is a brief outline of occurrences, up to the time when I was requested to give an opinion on the Ardglass Pier, when I visited the works a day or two after the last catastrophe, and on which I made a short provisional report for immediate purposes, on the 3rd December, 1838.

I have now, in compliance with the request of the Board of Works, to offer remarks on the following heads:—

1st. On the present state of the pier, and on the circumstances which might justify its reconstruction.

2nd. On the best steps to be taken during the present winter, to prevent further damage.

3rd. On the measures adopted by the Board of Works from the 3rd October (the period authority was given to expend a small sum in repairs), to the 27th November, when the pier and lighthouse were destroyed.

4th. On the principles adopted in the first construction of the pier.

On the first of these questions, I have to observe that the destruction of the pier appeared very great, but I consider all the most valuable ashlar stones might be recovered, either at low tides or by the diving bell; yet the whole structure, as far as could be observed, was greatly shaken, and the parts not carried away by the November gale must unavoidably be further damaged during the winter, extending, I should apprehend, almost to total dislodgment of the parts not founded on the solid bottom of the bay with the diving bell, and probably to lowering the extremity of the pier, which was so founded, down to the level of the breach, and perhaps down to low water; but to answer this question properly, a very minute and detailed inspection and survey is wanting, with plans and sections particularly, which cannot be properly taken until the days lengthen, as the periods of the lowest ebbs of the spring tides occur chiefly during the hours of darkness at this season of the year: it will require active exertions, and fine calm weather, to get the requisite details with sufficient accuracy.

To obtain this indispensable information at the least expense, I would suggest that an arrangement be made with the engineer for the county of Down, (supposing him to be competent to the task, and it requires a person well acquainted with the mode of taking such surveys and sections), and who is, I understand, resident only a few miles from Ardglass, to make a plan of the pier and the adjacent part of the harbour, &c., where the stone and rubble are deposited, with proper transverse sections and surface levels, carried down to low water mark, and as much below as can possibly be determined by soundings, &c. The spring tides between the 15th and 19th of March, and between the 13th and 17th of April in this year, will ebb very low, especially if accompanied by these winds in the Irish sea which sometimes assist; and if proper exertion be made, all the requisite work may be done at one, or, if needful, at both of these periods.

If necessary, I will with pleasure draw up full and detailed instructions for the surveys and levels, for the guidance of the person sent to make them; when obtained, the question may be answered with considerable accuracy, I may almost say, with certainty, as to the cost, facilities, and time of re-constructing the pier, and cleaning the harbour, and consequently enable the Board of Works to compare the amount of the expenses with the utilities of the work and situation; but until the proper measurements are made, I would not take upon myself to hazard an opinion. I should think that 50*l.* ought to cover all the expenses of such a survey, including the extra payment to the county engineer and his assistant, both out of doors and while on the office work.

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On the second point, I briefly stated my views in a letter of the 3rd December last, but may here repeat that, even with considerable funds, any effectual protection to the pier for this winter would be uncertain, from the scarcity of proper materials on the spot, and the difficulty and delay in procuring suitable stone from a distance at this season, as well as the risk of the stages, tackle, rails, and materials being repeatedly displaced by the constant gales and continued action of the waves. But with the small sum at command of the Board of Works, I am decidedly of opinion nothing ought now to be attempted, as it would be so much money thrown away.

On the third point, it is clear that the Board of Works having only received authority, on the 3rd October, to expend the small sum of 600*l*. or 700*l*., did not lose an hour in directing their engineer to proceed to Ardglass, which he appears to have done at once, accompanied by a most intelligent and experienced superintendent.

I cannot attribute any culpable neglect whatever, or any appearance of want of judgment to the officers of the Board. A difference of opinion as to the best steps to be taken on any great emergency will always arise among the most skilful and practical men; and it is easy to state, after the occurrence of a disaster, that some other measures than those adopted would have been more effectual in preventing it.

In the present case, I am of opinion that nothing but a considerable quantity of large and heavy stones, very quickly supplied, could have been effectual; and even this was contingent on the feasibility of securing the foundations of a wall already breached, and founded on the rubble and loose material, the mere sweepings of a quarry.

The only question was, how to obtain the proper stone in the shortest time; whether from the quarries on the spot, from the Isle of Man, from the granite district, from Donaghadee, &c. With ample funds, all these sources might have been put into requisition; but with the limited resources, and the short period of a month, little could be done, and on the whole it would seem that the supply of stones of proper size from the Isle of Man was more certain than from any other place: the Ardglass quarries might have been opened on a larger scale, and on a more effectual method, but for this, time was requisite, and certain preliminary expenses. When I venture to say that it would perhaps have been best to have merely filled the breach with the largest stones that could have been soonest got, even if by land carriage, keeping the opening filled as the waves washed the stones down, and bedding these displaced stones, so as to protect the undermined foundations of the parapets, I say so from a knowledge of what did afterwards occur and where: but I doubt if with the same previous knowledge possessed by the board officers, whether I should not have ordered Isle of Man stones, but probably in larger quantities.

On the fourth point, viz., on the principles adopted in the construction of the piers at Ardglass, I submit the following observations.

The cardinal errors which appear to me to have been committed in the construction of the Ardglass works are,—

1st. The great unnecessary expense of labour and materials bestowed in those portions of the work on the interior faces, and in parts not exposed to the direct action and weight of the waves.

2nd. An improper form in transverse section of the parapet and sea embankment.

3rd. An injudicious form in plan of the connection of the circular head with the pier.

4th. The want of a proper bonding of the face of the parapets, and the wall of the circular pier head, with the upper portion of the glacis or sea pavement

In respect of the first of these objections to the principles on which the work was carried on, it appears to have been equally evident to all the other engineers who have been previously consulted, and it is the more to be lamented since the same money which, I fear, has now been thrown away at Ardglass would, if it had been expended in a different manner, have produced equally beneficial results in constructing a good commercial pier, and have fully protected the same when finished, leaving a surplus to clear away the rocks and other obstructions, which is still requisite to be done, supposing the pier to be re-constructed to make Ardglass available as a general safety harbour, and even for the bringing up of large vessels and steamers within the port. It would be very interesting to obtain a minutely detailed account of the actual cost of each portion of the works, distinguishing materials, dressing, setting mortar, cement, preparations, filling, &c., and which account ought to have been kept by some person, or, if executed by contract, either the gross sum for each kind of work, or the schedule prices at which they were paid for, should be had. Such a document would prove in figures the amount of what can only be inferred from inspection by competent persons, though the difference of construction is sufficiently evident to an unprofessional eye. It would also be extremely useful in forming the future estimate of this work, and indeed of any similar one.

On the second point, I consider that the general slope for the glacis or sea pavement was too steep, being only four to one from the top of the bell work to the top of the parapet; the parapet was also too low by at least three feet for the run of the sea. The exterior face of the parapet should have been bonded into and formed part of the top of the glacis, and the interior face and the general body of the wall would have been better to have been strengthened with through bonds, and the foundation laid lower than it was. The accompanying sketch, No. 1, will explain my views, the lines in black being those of the original transverse section, and the lines in red show those which, in my judgment, and from my experience, I am of opinion would have been better.

As regards the bell work Toe, I am inclined to consider this was probably the most judicious step that could have been taken under all circumstances, although the Toe might have required, and indeed did require to be strengthened by materials laid outside, and which appears from the only one of the original sketches of Mr. Logan which is among the papers sent, to have been originally intended, even with a second Toe of a coarser kind outside of all.

Although an expensive operation it would seem to have been quite effectual, and the bottom courses of the glacis or sea pavement being secured at low water by being united with the bell work, if the foot of the exterior face of the parapet and upper courses of the pavement had been equally well secured by through bonding courses of the Isle of Man stones, I am of opinion that the intermediate portion of the sea pavement might have been laid to a great extent with the thin flat bedded stones from the Ardglass quarries (which could have been obtained in any quantity, and of considerable superficies), laid edgeways three or four feet deep in courses at right angles to the line of the pier, as suggested by one of Sir John Burgoyne's memoranda, the joints of which might have been again closed by rubble spawls, and wooden wedges driven down with the mallet, and the whole well flushed and pointed with thick groutings made from hydraulic lime and fine pebbles.

On the third point, I conceive that the re-entering angle, formed by the junction of the circular head with the straight line of the pier, offered a vulnerable point which all experience of sea works shows is most liable to be breached, and it was near this angle that the first breach was made, as might have been anticipated by those who have watched the effect of heavy waves raised by strong gales acting upon the re-entering angles of sea walls. This error in the principle of the construction of pier heads is not confined to Ardglass, and independent of the warning it should be, if this pier is to be rebuilt, it ought to be further considered in reference to other important works of the same kind in progress, not too far advanced to have the error remedied, which would be simply done by merely reversing the position of the projection of the circular head, keeping the outer line of the pier straight, and making the re-entering angle on the inner or harbour side, instead of on the outer or sea side, as in the annexed sketch, No. 2.

The fourth point I consider very important to be well considered in reference to the re-construction of the pier. As respects the union of the upper courses of the glacis or sea pavement with the lower part of the outer wall of the parapet along the general line of the pier, the preceding sketch, No. 1, will explain my intentions, and show the difference in the system executed and the one proposed; but it will require

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Vignolles, on the state of the Works.

a little further explanation as to the connexion of the circular pier head with the slope of the sea pavement, to the failure in effecting which in a thoroughly efficient manner may be attributed the destruction of the pier head and the fall of the new lighthouse. This stood exactly on the line (and in the direction of the wind and waves driving from the most dangerous quarter) of the imperfect junction of the battering wall of the circular head (brought up from the bottom to low water level by the bell, and formed of the first materials and excellent workmanship,) with the parapet of the pier, proceeding from the re entering angle, and on a reversing curve, to unite with the circular head, (the parapet being founded only just below high water mark, on an embankment of loose material, and stopped down on the slope of the embankment to unite with the bell work, the whole foundation being merely protected by sea pavement, stated not to have been sufficiently heavy, or of sufficient depth, and as represented by the superintendent as not being well bonded into the battering wall,), this junction (imperfect both in principle and in execution) occurring exactly along the part most presented to the sea, where the parapet formed unfortunately the only protection to the new light-house.

It is probable this portion of the sea pavement might have been finished thus imperfectly for want of funds. There is no documentary evidence before me as to the very precise spot where the original breach was made by the sea in the storms of the winter of 1837, 1838, but I understood, when at Ardglass, that it was at or close to the re-entering angle; and from some correspondence of Major Beauclerk, I find that when he first called the attention of the Board of Works to the disaster, the breach was only about 20 feet wide. This had increased to upwards of 40 feet, when inspected by Mr. Gibbons in June, and by Mr. Owen in July last, and the enlargement of the damage is clearly described in the report of Mr. Atwood, the superintendent, during the month of November last. The sketch annexed, No. 3, shows the circular head of the pier, &c., in vertical section, and the mode employed in connecting the foundation of the parapet with the bell work will clearly elucidate the mode of construction, Sketch No. 2, is the plan of the pier head. I should also add, that the peculiar shape into which the sea pavement was, as it were, twisted to be accommodated to the change of the pier, both in plan and section, had a tendency to weaken it, and required at least additional strength in materials.

Having thus replied to all the principal inquiries of the Board of Works, and having touched on all the points which appear to bear immediately on the question, I shall close my report with a deep expression of regret at the lamentable occurrence of the destruction of the pier and lighthouse, and a hope that a salutary application of the experience here taught may at some other place prove sufficiently beneficial to be a set off against this calamity.

I return herewith all the documents sent to me.

I have, &c.,
CHARLES VIGNOLLES,
Civil Engineer.

H. R. Paine, Esq.,
Secretary, Board of Public Works, Dublin.

No. 126.

No. 126.

Correspondence relative to Ardglass Harbour.

Correspondence relative to Ardglass Harbour, County of Down.

Treasury Chambers, 28th April, 1845.

SIR,

I am commanded by the Lords Commissioners of Her Majesty's Treasury, to transmit to you the following original documents relative to the harbour of Ardglass, in the county of Down, viz:—

1. Letter without date from Mr. Vernon, Private Secretary to the late Chief Secretary for Ireland, with the following memorials.

2. From the Commissioners of Ardglass Harbour. 3. From the Chamber of Commerce at Belfast. 4. From the Bankers, Merchants, and Shipowners of Liverpool. 5. From the Merchants and Shipowners of Whitehaven. 6. From 1200 Shipowners, Masters, and Mariners, who have occasionally visited the harbour of Ardglass during some months previously to January, 1845.

7. Copy of a letter from Mr. J. Saunders, Commissioner of Ardglass Harbour, dated 29th March, 1845, with its enclosure in original, from the Shipowners of Maryport.

8. Application of Ardglass Harbour Commissioners, with enclosure, without date and minute thereon, dated July, 1843.

9. Report of Board of Works, of 16th August, 1844, with enclosure and minute thereon.

10. Letters of Ardglass Harbour Commissioners dated 6th March, 1845, with a book relating to the harbour.

11. Also a letter from the Shipowners of Maryport, and—

12. The following letter from Sir T. Fremantle.

And I am to request that you will lay the same before the Lords Commissioners of the Admiralty, and move their Lordships to favour this Board with their opinion, whether the public advantages likely to be obtained from placing Ardglass Harbour in a proper state of repair, as compared with those which might be expected from similar works for which a demand exists in other quarters, are such as to render it advisable that a detailed inquiry should be instituted, with a view to an application being made to Parliament for a grant of money for the repair of Ardglass Harbour.

I have to request that the accompanying papers may be returned when no longer required.

I am, &c.,
C. E. TREVELYAN.

To the Secretary of the Admiralty.

Irish Office, 26th April, 1845.

SIR,

I am commanded by the Lord-Lieutenant to forward to you the enclosed copy of a letter which has been received from Mr. Saunders, one of the Commissioners of Ardglass Harbour, by which it appears that several petitions have been submitted to the Lords of the Treasury, praying that the harbour should be again put into such a state of repair as to render it an efficient harbour of refuge.

In submitting this subject for the consideration of the Lords of the Treasury, His Excellency desires me to state that my predecessor, Lord Eliot, was much impressed with the importance of repairing and keeping up this harbour, and in which I entirely concur.

His Excellency hopes that their Lordships will be favourably disposed to afford some assistance, particularly as it is of urgent importance that something should be done during the ensuing summer, in order to prevent the further great injury to the present works, which would be occasioned by their being left in an exposed and dilapidated state during the storms of another winter.

I am, &c.,
THOMAS FREMANTLE.

To the Secretary of the Treasury.

APPENDIX B.

ARDGLASS.

No. 127.

Beechey, on the Harbour.

No. 127.

Report by Captain F. W. BEECHEY, R.N., F.R.S., *on Ardglass Harbour.*

SIR, *H.M.S. "Firefly," Pembroke, 4th May,* 1845.

Ardglass is not, in my opinion, worth the money it would take to repair the pier, either as a harbour of refuge or as a place of resort for more than one steamer in bad weather. The harbour is too confined, the water at its entrance too deep and within too shallow, for it ever to become a place of refuge with easterly gales, when alone it would be required as such.

As a snug little cove, where a steamer might pass a night, or land her passengers and be off (which I think she could not do in an easterly gale), or where fishing-boats might resort and lie aground, it is all very well, and a pier would render it more safe than it is at present; but as regards the navigation of the Irish Sea, I do not think it worth the particular attention of the Government.

You will observe, that the new pier, with the lighthouse at the end of it, was scarcely finished when the whole fabric fell into deep water. I think the same outlay that would be required to rebuild this pier and make it efficient, might be more advantageously employed.

I am, &c.,

To the Secretary of the Admiralty. F. W. BEECHEY, *Captain.*

KILLOUGH.

No. 128.

Evidence taken on the 3rd of October, 1845.

No. 128.

PORT OF KILLOUGH.

Examining Commissioner—Captain WASHINGTON, R.N., F.R.S.

Present—Captain DESPARD, R.M., Captain BROWNE, Mr. RUSSELL, and Mr. M'MULLAN.

WILLIAM M'CULLAGH said, that he had been employed as pilot at Killough during the last eighteen years, and had been coasting for forty years. On several occasions he brought vessels into the harbour during a storm, wind sometimes south-west, south, and east; rode within the Water-rock and had good holding ground; there is a channel on both sides the harbour; brought in a vessel in distress wanting anchor and cables; ran her up to her bends in mud. There are rocks at the entrance; the shore is not iron-bound, nor is there a heavy sea at the entrance of the harbour. Knew Coney island Bay; there is good holding ground there: a vessel can ride in it with wind at south-east by south. Never knew any vessel break her anchor in the harbour, or be wrecked, except one on the Water-rock; could not tell how many vessels enter this harbour in a year; a vessel of two hundred tons' burthen could work out when the wind was right in, and good shelter could be procured by erecting a pier at the Water-rock, which, with a harbour light, was the only thing required.

A statement was here put in, showing the yearly export tonnage, amounting to 10,000 tons (old); tonnage of vessels belonging to Killough, 913 tons.

Mr. **RUSSELL**.—Vessels of 150 tons were built and launched here. Upwards of five hundred head of cattle were shipped here for England, but the greater number had to go to Warrenpoint, a distance of nearly thirty-eight miles, or to Belfast, a distance of twenty-four miles. This was attended with great expense and inconvenience, and considerably longer sea passage. When a railway communication from Downpatrick would be established, the traffic would be very considerable and profitable, as two steamers, of 200 tons' burthen, would find employment.

Mr. **M'MULLAN** expressed an opinion that Killough would be preferable to Ardglass as an asylum-harbour for vessels in distress, and much more safe.

GEORGE HANNA, pilot for fifty years, knew of but one vessel wrecked here—would prefer Killough, even at low water, to any other port between Greencastle and Strangford Lough.

HENRY SMITH, pilot, stated that vessels could safely enter Killough harbour at any time; all the fishing vessels put into Killough in preference to Ardglass; an extended pier was required to make it a refuge harbour; vessels could enter at low water.

NEWCASTLE.

No. 129.

Evidence taken on the 4th Oct., 1845.

No. 129.

NEWCASTLE—*Dundrum Bay.*

Examining Commissioner—Capt. WASHINGTON, R.N.

Present:—The Rev. J. MOORE, Trustee of Lord Anoesley; W. HUNTER, Esq., of Castlewellan; Captain OLIVER, Inspecting Commander of the Coast Guard; W. BEERS, Esq., J.P.; Mr. SHEE, Principal Officer of Customs; Lieut. CARROLL, R.N., of the Coast Guard; Mr. HYLAND, &c. &c.

[*The Admiralty Charts of this district, by Capt. Mudge, R.N., and the Plans and Prospectus of the proposed Asylum Harbour, by Mr. Mackenzie, C.E., were laid on the table.*]

ROBERT MARTIN examined.—Has been twelve years resident as Harbour Master; the pier was first built thirty years since, and has proved extremely useful to fishing-vessels and the coasting trade. About six years ago the outer end was breached by heavy gales from the S.E.; no steps were taken to remedy it; each winter it became worse, and now all the outer part is washed down, and the ruins encumber the harbour, whereby great evil arises to the fishermen and coasting trade; there is much traffic in coal imported, and cattle exported; even in its present state the pier has been the means of saving many vessels; great discouragement to both fishermen and sailors to see the pier left in its present ruined state, and another winter may destroy it entirely; stones at hand in abundance, and 50*l*. laid out at once, would probably save it from destruction this winter; all the dues levied do not amount to 18*l*. a-year. Remembers seventeen vessels wrecked in the bay, chiefly between St. John's Point (7½ miles to the north-east) and Dundrum Harbour; has heard great and repeated complaints of the want of a light on St. John's Point; believes two or three memorials on the subject were sent to the Ballast Office of Dublin; is of opinion that a light on that point would have been the means of saving several of the vessels; only one has occurred since the lights were placed, eighteen months ago, and that vessel (the *Frolic*) had no business where she was; the worst gales are from the south-east; thinks a harbour of refuge much wanted; the entrance should be to the N.E., and not to the E.S.E., as shown in the plan.

THOMAS M'KIBBIN examined.—Has been twenty years a fisherman out of Newcastle; testifies to the value of the pier to all fishermen; but now the slip, the pier-head, the mooring-rings, are all gone, and much destruction of property has taken place in consequence; if repaired, and carried out into rather deeper water, it would be very valuable to the coasting trade. A harbour of refuge is much wanted;

Appendix B.

Newcastle.

No. 129.

Evidence taken on the 4th Oct., 1845.

recollects many wrecks, three of them at three miles to the north-eastward of Newcastle: four between St. John's Point and Dundrum; and three more at Leestone Point, nine miles to the southward; the life-boat formerly stationed at Newcastle, was removed a few years since to Tyrella, five miles to the north-east, that being the spot where most wrecks take place; thinks an asylum harbour at the Stag Rock would be very useful.

Michael Sterling—Was many years a fisherman, and partly in the Coast-Guard service; the old pier was extremely useful; has known five vessels saved by it in 1839; now, owing to its ruined state, many vessels are obliged to leave it; the want of a good pier is a sad loss to fishermen; they are now obliged to carry their heavy baskets of fish over loose rough stones at risk of their limbs; thinks a large refuge harbour much wanted; its opening should be to the north-east; a ship once embayed has no possibility of escape.

Daniel Mackey—Commands a coasting vessel, trading between Newcastle and Whitehaven, in the coal trade; carries as many as 50 head of cattle each voyage; makes twelve voyages in the year; the pier was of great value before it was destroyed; formerly there was room for ten vessels, now only for two; has seen 150 fishing vessels, many from St. Ives, taking shelter in the bay and pier; thinks an asylum barbour much wanted, as shelter from the south-east gales

Mr. John Hyland—For 40 years has resided at Newcastle; has known many wrecks take place in the immediate neighbourhood. Witness furnished the list of 63 wrecks in the last 63 years, appended to Mr. Mackenzie's report; the greater numbered occurred near St. John's Point, at Tyrella; many lives have been lost; a harbour of refuge would have saved both life and property; great complaint of want of light on St. John's Point; memorials praying for it were sent to the Ballast Office at Dublin; only one wreck has occurred in the bay since, and she (the *Frolic*) ought not to have come ashore; if a good harbour were erected, the traffic would greatly increase, as more than one railroad is likely to approach the port; at present much produce that should be shipped here is carried at a great expense to Newry and Belfast; whinstone and granite are in abundance close at hand, and a harbour could be constructed here at less cost than at any other part of the cost.

Lieutenant A. D. Carroll, R.N.—Has been stationed three years at Newcastle, in the Coast Guard; considers the pier of great use to the fishermen and coasters; has been the means of saving many vessels; if repaired and carried out into deeper water, its value would be doubled; vessels of 18 feet draft would come alongside at high water springs; no life-boat is stationed here, nor is it wanted, as wrecks do not occur at Newcastle, but chiefly at St. John's Point, where the life-boat now is. A harbour of refuge is much needed, both for the outward-bound trade in south-west gales, and for the inward-bound in north-east gales; the worst storms are from the S.E., yet heavy squalls come from the north-west; is of opinion that the Stag Rock is the best site for a harbour; it should open to the north-east; would not fear damage from inducing vessels to run into the bay for it; went with the engineer to take soundings at neap tides; sounded out to three fathoms and a half at low water; thinks the southern pier head should cover the northern; the engineer was never here at low water springs; St. John's light is the greatest benefit on this part of the coast; thinks that it was not intended to show into Dundrum Bay; never saw a Ballast-office notice respecting it; is of opinion that such notices should be freely distributed along the coast; the coast guard would circulate them if required.

Captain Oliver, R.N., Inspecting Commander of the Coast Guard, stated, that he considered the free circulation of notices of new lights of such importance, that he felt confident the Comptroller General, if applied to, would sanction their distribution by the coast guard. As a sailor, he considers it most reprehensible that such notices should not be made as public as possible in all places frequented by sailors.

Mr. Shee, principal Officer of Customs.—The pier was originally built in 1808, by a parliamentary grant, but not finished; it was completed in 1829, by Lord Annesley, at his private expense; has been of great value to fishermen, coasters, and the trade of the port generally. St. John's Light would have saved many of the wrecks which have occurred in the bay; took an active part in having the light placed, as did also the late Lord Downshire; no greater boon has been conferred on shipping in this part of the coast. Is of opinion that an asylum harbour is much wanted; it would be of great benefit to the local trade, as well as to the whole trade of the Irish Channel; stone is in abundance, good deep water near the shore, and every facility for its erection in the site proposed.

The Commissioner here mentioned that he had just received a written statement from Mr. John Adam, formerly stationed on the Coast Guard at Newcastle and now at Bangor, assigning at length four reasons for placing a safety harbour at Newcastle, which he would briefly state. 1st. Its position on the east coast, half way between Dublin and Belfast. 2nd. The deep water close to the shore. 3rd. Facility of access and egress. 4th. The advantage of good land-marks in making the coast.

John Taylor, Commissioned Boatman in the Coast Guard, examined.—Has been three years resident at Newcastle; the pier is of great benefit to fishermen, coasters, and general accommodation to the neighbourhood; was present at the wreck of the *Frolic* last winter, off the pier-head; went out in the Coast Guard boat, and was the means of saving the lives of some of the crew, for which he received a silver medal from the Shipwrecked Mariners' Society; the rest of the crew were brought on shore by James M'Vae, a fisherman; wrecks chiefly occur to the eastward of Dundrum Bar; the light at St. John's Point is very valuable; had heard numerous complaints of the want of it; never saw a notice of the light from the Ballast Office; is of opinion that a refuge barbour is much wanted in the bay; there is great traffic along the coast, as well as in the Irish Channel; it might be the means of saving many lives, and property to a large extent; was present when the wreck of eight fishing yawls took place two years ago, when 46 lives were lost, and 210 widows and children left; the boats were blown off shore in a N. W. gale; a liberal subscription to the amount of 4000*l*. was raised, to which the Shipwreck Institution contributed 100*l*., and 12 of the widows are well settled in comfortable cottages in Newcastle.

Rev. J. R. Moore, as Trustee to Lord Annesley, stated that so great appeared to him the necessity of a pier for the use of the coasting trade and fishermen, and so imminent the peril of its being entirely destroyed if left exposed during this winter, that he would give 40*l*. on the part of his Lordship to secure it for the present, in the hope that government might be induced to complete its restoration in the spring; everything was at a stand-still for want of it; coals, lime, and cattle, all stopped; the coasters would be driven away, and the poor fishermen ruined, if the pier were not restored. 200 feet of the foundation are still untouched, stone is lying ready, the quarries close at hand, and most of the tools (as well as the tram-way) used in building the outer part still available; and he would venture to say, on the part of Lord Annesley, that his trustees would cordially co-operate in any plan for its restoration.

APPENDIX B.

NEWCASTLE.

No. 130.
Account of Wrecks in Dundrum Bay.

No. 130.

Number of VESSELS wrecked in the Bay of Dundrum, from the Year 1783 to 1845.

Date.	Name.	From Where.	Where Bound.	No. of Lives Lost.	Value.			Exact Spot of Wreck.
					£.	s.	d.	
1783	Hector	Leghorn	Dublin	..	38,700	0	0	1½ m. N. of Newcastle.
1784	Nancy	Liverpool	Drogheda	..	300	0	0	
,,	Not known	——	Norway	..	1,000	0	0	
1785	Recovery	Glasgow	Carlingford	..	1,500	0	0	
1786	Margaret	Bristol	Belfast	..	3,000	0	0	
1787	Britannia	Newport	Wicklow	..	500	0	0	
1788	Kent	Glasgow	Jamaica	..	20,000	0	0	
,,	A Sloop	Dublin	Belfast	..	500	0	0	
1789	James	Greenock	Cork	..	7,000	0	0	
1796	Nymph	St. Ives	St. John's	..	1,000	0	0	Newcastle.
1797	Mermaid	Liverpool	Africa	..	2,000	0	0	Ditto.
1799	Barmouth	Liverpool	Newry	..	500	0	0	Ditto.
1800	May	Whitehaven	Dublin	20	500	0	0	1 m. South of Dundrum.
1802	A Smack	Liverpool	Drogheda	..	200	0	0	Dundrum-bar.
1803	A Brig	West Indies	London	..	3,500	0	0	Tyrella.
1804	Castor	Demerara	London	..	40,000	0	0	Ditto.
,,	A Brig	——	St. John's	..	1,000	0	0	Ditto.
,,	A Ship	Liverpool	America	..	1,500	0	0	Ditto.
,,	A Brig	Dublin	Belfast	..	7,000	0	0	Ditto.
1807	Satisfaction	Liverpool	St. John's	..	2,000	0	0	Newcastle.
1809	John	North Shields	St. John's	..	1,000	0	9	1 m. N. of Newcastle.
,,	Lucy	Savannah	Liverpool	..	15,000	0	0	Bar of Dundrum.
1810	Elizabeth	Jamaica	Belfast	..	10,000	0	0	N. Bull of Dundrum-bar.
,,	A Letter of Marque	Liverpool	South America	..	1,000	0	0	S. Bull of Dundrum bar.
,,	John	Liverpool	St. Vincent	..	1,665	13	3	Tyrella.
,,	Hornby	Liverpool	Newry	4	500	0	0	Half m. from Newcastle.
1812	Johanna	Petersburgh	Dublin	..	1,000	0	0	1 m. S. of Dundrum.
,,	Margaret	Liverpool	Newry	..	2,000	0	0	Tyrella.
1813	Neptune	Milford	Liverpool	..	10,000	0	0	Ditto.
1814	Duke of Richmond	Liverpool	Drogheda	..	500	0	0	Clanmaghery.
,,	Industry	Dublin	Strangford	..	700	0	0	1½ m. from Newcastle.
1815	Recovery	Carlingford	Newcastle	..	50	0	0	Newcastle.
,,	Roberts	Irvine	Dublin	..	200	0	0	1 m. from Newcastle.
,,	Auspicious	Liverpool	Newry	..	4,000	0	0	Ditto.
1816	Wallace	Liverpool	Newry	..	200	0	0	Newcastle.
1818	Minerva	Liverpool	Belfast	..	2,000	0	0	N. Bull of the Bar, Dundrum.
,,	Ruby	Liverpool	Newry	..	100	0	0	1½ m. from Newcastle.
1819	Messmate	Liverpool	Killough	6	200	0	0	Sunk in the Bay.
,,	Louisa	Liverpool	Killough	..	300	0	0	At Dundrum-bar.
1821	Prosperity	Westport	Liverpool	..	500	0	0	1 m. from Newcastle.
1825	Superior	Greenock	America	..	6,000	0	0	Tyrella.
1826	Richard Pope	Liverpool	Sierra Leone	1	4,000	0	0	Newcastle.
1827	Blue-eyed Maid	Liverpool	Dundrum	..	200	0	0	1 m. from Newcastle.
1829	Sir James Kemp	St. John's	Liverpool	..	9,000	0	0	Tyrella.
,,	A Brig	Liverpool	Lisbon	..	10,000	0	0	Ditto.
1831	Delaford	Liverpool	Lisbon	..	1,000	0	0	Ditto.
1833	Heroine	Swansea	Dublin	..	500	0	0	Ditto.
1834	——	Liverpool	America	..	5,000	0	0	Ditto.
1837	Cœur de Lion	Liverpool	America	..	15,000	0	0	Ditto.
,,	George	Swansea	Liverpool	..				
,,	Bellona	Liverpool	Mobile	..	1,000	0	0	
,,	Unicorn	——	——	..				
1838	Constitution	Liverpool	America	..	10,000	0	0	1 m. from Newcastle.
,,	John Stamp	Bombay	Liverpool	..	20,000	0	0	Rosglass.
,,	Friendship	Bangor	Belfast	..	300	0	0	Lee Stone.
,,	A Brig, stranger	Liverpool	Derry	..	200	0	0	Tyrella.
,,	Rapid	Bangor	——	..				Ditto.
,,	A Schooner	Bangor	Belfast	6	300	0	0	Ditto.
,,	British Heroine	Liverpool	Mobile	4	4,000	0	0	Ditto.
1839	A small Smack	——	——	3				Newcastle.
,,	A Schooner	Belfast	Strangford	..	400	0	0	Tyrella.
1840	Eagle	Liverpool	Newcastle-on-Tyne	..	1,000	0	0	Ditto.
,,	Kincardineshire	Liverpool	Aberdeen	..	2,000	0	0	Ditto.
,,	Trevor	Marseilles	Belfast	..	1,000	0	0	Ditto.
1843	Peace and Plenty	Drogheda	Campbeltown	..	600	0	0	1 m. S. of Dundrum.
1845	Frolic	Liverpool	Dort, Holland	..	400	0	0	Newcastle.
,,	Red Diamond	——	Newry	..				
				44	251,415	13	3	

In 1838 three fishing wherries were stranded off the Bull, on the northern part of the beach at Newcastle.

In 1843 eight fishing yawls were blown off shore in a N.E. gale; 46 lives were lost, and 210 widows and children left.

NEWRY.

No. 131.
Evidence taken on the 6th Oct., 1845.

No. 131.

PORT OF NEWRY.

Examining Commissioner, Captain WASHINGTON, R.N., F.R.S.

Present:—Lord NEWRY and MORNE, M.P.; JOHN BOYD, Esq., Seneschal; Mr. CARVILL; Mr. J. H. QUINN; Lieutenant SERVANTE, R.N.; Mr. C. JENNINGS; Mr. FRAZER, C.E., &c. &c.

HUGH BOYD, clerk to the Newry Navigation Company, examined.—I am secretary to the Newry Navigation Company, and have held the office since the formation of the company; this is the Act for its formation—[produces the Act]—the entire of the navigation, from Lough Neagh to Carlingford, is embraced by it—about 32 miles in length; the accounts are annually made out and audited; they are not published, however, but are furnished to any of the members who may apply for them; I am not aware that there is any necessity for their publication; the Navigation Company is a private

APPENDIX B.

NEWRY.

No. 131.

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company; it can divide 12½ per cent. amongst the shareholders; we were never applied to to furnish the accounts to the House of Commons; I never saw any order of the House of Commons to that effect; I have heard no complaints of the amount of the dues; the company has borrowed 27,000*l.*; has authority to borrow 80,000*l.*; pays 5 per cent. to the Board of Works for it; I think this high, and that we could get it at 3½ per cent.; the whole debt of the Company is 27,000*l.* at present; the whole expenditure is 48,000*l.*, that is, on the river navigation; a sum of 5,000*l.* was borrowed, to be paid next year; we have borrowed in all 32,000*l.*, and repaid 5,000*l.*; the length of the canal navigation is 17 Irish miles; the Navigation Company keep up this; we have expended on the inland canal 10,148*l.*; it was formed about 100 years ago; 48,000*l.* have been expended on the canal works; we have a contract to finish the canal from Doyle's Hole to Newry for 40,000*l.*, and we expect it will be finished next year; we widened the river and deepened it about 5 feet; it is about 13 miles from Fatham to the Bar; the annual cost of the establishment is 474*l.*; this includes salaries and all; the annual income from the whole is 3,948*l.*; the inland is 1,400*l.*; the revenue of the navigation, prior to 1830, was 2,403*l.*; the Bank of Ireland is the treasurer; I keep all the accounts; they are audited once a year; I can give returns of the arrivals and sailings from 1830 to 1845, the former year being that in which the present Company got possession of the works; the arrivals in the last year are 2,435 passing inwards and outwards.

Mr. JOHN RAMSAY examined.—I have been resident engineer to the Newry Navigation Company for the last 11 years; there had been two engineers before me; I found, on my entering office, the water was much too shallow; the depth now is five feet in the canal from Lough Neagh to Newry, and from Newry to Fatham 10½ or 11; it is found to grow shallower about two inches in the year; the width of this portion is 22 feet; it diminishes, from Newry, to 15 feet; there are 13 locks on the navigation; the rise to the summit level is about 50 feet; Lough Neagh is about 48 feet above the level here; from Fatham downwards vessels drawing 7 feet water could not formerly go out or in except at spring tides; now vessels drawing 11 feet can go out and in; the whole is under the superintendence of Sir John Rennie; I have bored in the vicinity of the works to the depth of 60 feet, and found no obstruction; in some cases there is some difficulty experienced in getting a foundation; the works will be finished next year; there are about 400 men on them now, including quarrymen and all; we have obtained a foundation in all cases, although in some with difficulty; the locks are now in progress, and the foundation is a good one; it is a hard, gravelly soil; at spring tides we have 18 feet water at the locks; the width will be 22 feet; there will be three gates on the principal lock, and opening one of them will be sufficient to admit small vessels; the water will be saved by this; we have abundance of water, however; at neap tides there will be 15 feet; I think the cheaper and better plan has been adopted in the improvements now going on; the whole will be completed next year; we provide for the safety of the banks by facing them with stones, and to guard against damage from steamers, &c.; the filling up of the river is caused by a deposit from the sea, as the water of the river takes away more than it brings; the river for the last five years has maintained its depth; it was thought wiser to extend the canal to Doyle's Hole, as by dredging the river constantly, the cost would amount to probably 1,000*l.* a-year; the marsh has been banked in from the river; this was done in 1740; the Company would not allow of such an embankment at present, as it has always an injurious effect on rivers; it is found a considerable disadvantage to the steamers stopping at Warrenpoint; they will not do so when the new canal is opened; I think the 40,000*l.* contracted for to finish the canal might have deepened the river so as to admit steamers; at Narrow-water there are some rocks in it; there are only seven feet at low water there; we have five feet in another place; both of these portions will have to be deepened; we have a diving bell, and a good dredging machine; our machine has a great many improvements; it is so superior that engineers have come from the Shannon to see it; it was made by Coates and Young, of Belfast, and has been improved under my own superintendence; we have a large working plan of the river, but it is in the Navigation Office; we have seven feet at low water at Warrenpoint; we keep a daily register of the tides—that is, of high water; it is the lock-keeper does this; we make the tidal observations twice a-year, continuing a fortnight at a time; there is a blue clay on the bar; this is the kind (producing a tobacco pipe formed of it); I bored to the extent of 18 feet, which is all the same description of clay; I think there would be no difficulty in deepening the water there; it would require a dredging machine with a longer ladder than the one I have; our machine is, however, perfectly suitable in other respects; it cost 4,000*l.*; I could deepen the bar with my own machine better than any other but for this; it is 6½ miles of river from Newry to Warrenpoint; I think we should go to the depth of 18 feet; we still want that; I have not made any calculation as to the number of cubic yards it would be necessary to remove; I think it could be removed for about 9*d.* a-yard; I think the whole could be done under 50,000*l.*; there is no harbour on the coast at all equal to Carlingford harbour; there is no harbour of refuge from Kingstown to Belfast; Carlingford would answer well for the purpose; I came from the Clyde to this country; I was assistant engineer in building the new bridge there, and at the erection of other works; I think Carlingford would form one of the finest safety harbours it is possible to conceive; there is the Earl-rock in it, but it can be avoided or removed; we are careful in the canal works not to injure the river; I can state the quantity of soil we have dredged up.

Captain WATSON examined.—I am a harbour-master, water-bailiff, and agent for Lloyd's, at Warrenpoint; when I was first acquainted with the bar, vessels of 400 to 500 tons would come over it. There is a patent slip for vessels at Warrenpoint, but it is not completed; there are two new vessels on the stocks at Newry; they will be launched broadside ways; when the patent slip at Warrenpoint is finished, it will admit vessels of 750 tons; there are two departures and two arrivals of steamers weekly at Warrenpoint, for and from Liverpool; the largest tonnage of vessels now coming to Warrenpoint is 784 tons; in 1825, there was only one small steamer trading between Warrenpoint and Liverpool; the largest vessels belonging to the port is one of 725 tons; the only difficulty to vessels coming up is the bar; there are nine feet on it at low spring-tides; I recollect Captain Mudge examining the bar; if it be not irrelevant, I would read his letter. [Captain Watson then read two letters, the one dated the 4th, and the other the 26th June, 1839, relative to the examination of Captain Mudge; they stated the practicability of deepening the bar, removing the existing obstructions, the importance of such to the port of Newry, and the consequent advantage to vessels of large burthen.] A very serious wreck took place outside the bay, in 1839; the vessel was the "John Stamp," from Bombay to Liverpool; I can state several other wrecks; all these might have been prevented by the bar being improved and deepened; another vessel was driven on Cranfield Point, and could have gone in if the bar had been deepened; the "John Stamp" was wrecked about three miles from the mouth of the bar; she might have been saved by getting over the bar; these wrecks occurred with an easterly

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wind; I do not think there is any difficulty that would have to be overcome, with the exception of the bar; there is one rock, but it could be easily removed. Lord Anglesea levies duties on vessels entering the port, to the amount of about 85*l.* to 90*l.* a-year; this is entirely independent of the Navigation Company. I have, in some instances, received complaints of the state of the buoys and perches; I did not consider myself warranted in going to the extent of the expense that would have been required to remedy the matters complained of; the complaints were remedied to some extent. There are very good lights at the entrance of the Lough; there have been no complaints respecting them; there was one light placed in a wrong position, which was removed to a proper one; I never heard a complaint respecting the two on the Hawlbowline appearing as one; a vessel was lost on the Helly Hunter, in the year ——; it was by S.E. wind and thick weather, so that the lights could not be seen; I do not know of any vessels being lost within the bar; the "Herald" steamer was lost in 1839, in a snow storm; the snow fell into the binnacle, and the captain could not see the compass so as to steer the vessel; I heard no complaints of the light being too dazzling; there is a buoy on the Earl Rock; it is about 2½ feet in diameter; I have no funds to erect large buoys; the two steamers pay about 20*l.* a-year each for anchorage dues.

Mr. **FRANCIS CARVILL** said there had been no outlay for repairs of the kind alluded to these many years.

Examination continued.—The buoys have been cut away, and I have repeatedly had to offer rewards for the discovery of the perpetrators. I have not any copy of the charter upon the authority of which I levy the dues. I will read a letter I have received from Colonel Armstrong, which states that all the duties would not keep the buoys in order.—[Captain Watson then read the letter alluded to].—I have rented the dues from Lord Anglesea; I am decidedly of opinion that the bar is capable of being removed, and a harbour of safety formed, at which there would be none equal from Cork to Belfast.

Mr. **JOHN CARAHER** said, the docks at Warrenpoint were constructed with the public money. Mr. Hall owns the property, and has extended and improved the docks very much.

Mr. **ISAAC COARY** said, that Mr. Hall levied dues connected with the docks, and was perfectly ready to try his legal right to them.

Captain **WATSON'S** examination continued.—I think about 200*l.* a-year is expended on the repair of the docks.

Several gentlemen said that the accommodation at the quays was insufficient.

Captain **WATSON.**—There is very excellent accommodation for ships at the quays. I have received no complaints relative to the state of the fenders. The tolls are levied on the cattle, and each steamer pays 1*l.* each voyage a-week; there are about 150 head of cattle exported weekly; 4*d.* is paid on every horse, 2*d.* on every cow, and 1*d.* on every pig and sheep; the amount of the dues is about 500*l.* yearly, not including anchorage.

Mr. **SAMUEL SMITH**, agent for the "Magnet" steamer, here read a statement of the total number of cattle exported by the steamer "Magnet," from Warrenpoint to Liverpool, for the 12 months ending 1st June, 1845:—

				£.	*s.*	*d.*
392	Horses, which pay dues at Warrenpoint, at		4*d.* each	6	10	8
4255	Cows,	ditto	2*d.*	35	9	2
5709	Sheep,	ditto	1*d.*	23	15	9
9265	Pigs,	ditto	1*d.*	38	12	1
				104	7	8
	Dockage, 102 trips, at 20*s.* each			102	0	0
				206	7	8
	Anchorage, 102 trips, at 5*s.* each			25	10	0
				£231	17	8

Some gentlemen said there were complaints of the preference given to Newry vessels, in the collection of the dues.

Mr. **FRASER**, county surveyor, stated that the committee of the Great County Down Railway Company, anxious to afford every information, had directed that a series of observations, regarding the rise of tides at the different ports with which their railway would communicate, should be made. For this purpose tide-gauges would be erected at Belfast, Donaghadee, Ardglass, and Warrenpoint; the observations would fix the tide-levels of the different ports, and would be carried on under the immediate direction of his brother (William Fraser, civil engineer), who had considerable experience in these matters.

In reply to a question from the Commissioner, as to the different railway projects that would affect or bear upon the trade of the town of Newry and the neighbourhood, Mr. Fraser stated that the first was the Newry and Enniskillen Railway, for which a Bill was obtained last session; that this railway united the west of Ireland with the north and east, passing by Enniskillen, Monaghan, Armagh, and on to Newry, where it terminated. The line was a fine one, and would afford great traffic. The next was the Great County Down Railway, that ran from Belfast, by Comber, Downpatrick, Castlewellan, and Rathfriland, to Newry, ending at the quay of Warrenpoint, with branches to the ports of Donaghadee and Ardglass, and the town of Banbridge; that this line would unite the towns of the large district of the county Down, and greatly increase the trade of the town of Newry. That a line was spoken of between Newry and Carlingford, but that he had not seen the prospectus. That he had no doubt these railways would afford immense advantage to the public, and make Newry one of the finest towns in the kingdom. That, as far as respects Carlingford Lough, he was of opinion that, at a moderate expense, the bar at the entrance of the harbour could be removed; and that, if this were done, Carlingford Bay would be capable of affording shipping accommodation to any amount; and that if so done, the harbour would be much preferable to any harbour made artificially on the open coast. Would forward to the Commissioner a copy of all the observations regarding the tides on the coast.

Mr. **CARVILL** said—I am a large shipowner; limestone can be procured from Omeath at the rate of 6d. per ton; the dock should be at the Omeath side, in my opinion.

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Captain **MORELL** examined—I am acquainted with Newry harbour since 1837; I made two voyages to this port; I consider there is a very fine bay at Carlingford; dry docks are much wanting; I am not acquainted with the shore inside the bar; the port of Newry is the only place between Dublin and Belfast for a large ship to take refuge in; I am not acquainted with Strangford or Ardglass.

Mr. **RAMSAY** said he thought that the bar, if once cleared, would never fill up again; if once removed, the strength of the current would prevent any deposit there in future; the difference in the tide at Cranfield Point and Newry was nearly an hour; at Newry the river is nearly dry at low water; it is not more than nine feet deep at Newry, at high water; above the Dublin bridge there is a weir which goes into the river; the height of the dam above the bed of the river is three feet; the dam is very old; the daily flow of the river would not be sufficient for vessels if the channel were cleared; the last quarter of the ebb and the first of the flood are the best for scouring the channel.

Mr. **NEWSOM**.—There is another weir one mile and a half higher up, for an oatmeal mill; Mr. Coulter has another one mile higher up again; the Newry mill has the first weir, and Damolly mill the next; there are no other embankments or weirs; the fall of the river is about 10 feet; the tide formerly went up as far as Damolly.

Captain **WATSON** said that immense quantities of limestone, he believed to the amount of one million tons annually, were taken away from the Omeath side.

Captain **THOMPSON** examined.—I am master of the steamer "Magnet;" I have been commanding her for three years, and she is at present trading to this port; there have been no improvements made at the port since I knew it; the chief difficulty at this port is the bar; I have seen the bar at low water; the bar is very narrow; it is composed of boulder stones and blue clay; it is not more than one-third of a mile or four cables in width; four cables' length in width are sufficient for working a ship; if we had a channel, ships could come into Carlingford harbour at any hour of the night; vessels from Liverpool here sail with a southerly wind; if they make three points lee-way, they will have nothing but St. John's Point on their lee; the worst wind is a south-east wind; with the wind at south you can weather St John's Point; the sea is too heavy at St. John's Point, and no ship dare take it unless at an ebb tide; I have tried it in a ship of 360 tons; with the wind at south, vessels can make Carlingford harbour, and it is the only harbour they can make; I have known 100 ships with a south wind to enter Carlingford harbour.

Lord **NEWRY** said he here wished to mention the case of a boat which was wrecked and went ashore at Annalong, whereas if the bar had been deepened, it could have taken refuge in Carlingford, where it would have been quite safe.

Captain **THOMPSON**, in continuation.—Last November I led a large schooner into safety in Carlingford harbour; once over the bar there is no danger, if the shoals were properly booyed; the Earl Rock could be blasted; from Soldier's Point on the north side up there should be buoys; there should be a buoy at the Block-house.

Captain **OWENS** here said that all the vessels which had been wrecked were wrecked at the Block-house, and he would mention the names of the "Herald," the "Tarholton," the "Countess of Roden," the "Clarence," and the "Peggy Arnoll," which were all wrecked on the skirt there; and the farmers would remove it if they were permitted, as it was good limestone, but a man named M'Ilmy would not permit them; the tide he (Captain Owens) thought was too rapid at Carlingford, and the sooner the entrance was widened the better.

Mr. **HENRY**, the Agent of the Kilmorey Estates, said this was the first time he had heard the complaint made about the Block-house; and he was certain, if a proper application, based on substantial grounds, had ever been made to either the late Lord Kilmorey or the present trustees, they would be most happy to do, as far as in them lay, all that was necessary in the matter.

Captain **THOMPSON**, in continuation.—The perch on Stalkey should be much larger; Soldier's Point should also be marked; the Earl Rock should also have a larger buoy; Greenore Point could not be better; there is a revolving light there; my opinion is that the outside light should be a revolving light; St. John's light is a flash light; the Calf of Man has a revolving light; in passing Greenore you are sometimes dazzled; Watson's Rock requires a buoy; Killowen Point has a good buoy; in my opinion, there should be a light-house at the Black Rock, as there is a rock opposite it; there is no harbour-light at Warrenpoint; Omeath bay is the anchorage for ships, and, therefore, harbour-light is required at the Gnnoway Rock; there is no water-bailiff or harbour-master in Warrenpoint, who has power to compel vessels to put up lights; in the anchorage-ground they throw ashes and everything else overboard into the bay; the sand at Scar, I think, should be removed; at Warrenpoint we are obliged to lie 20 feet off the pier; there are no sheds; we pay 25*s.* of dues each trip, and we have not sufficient accommodation; there are no mooring-posts, and only one or two mooring-rings; we are afloat always at the pier when we have no cargo; there are six feet of water where we lie off from the pier; there are no cranes at Warrenpoint or at Newry; the revenues of the Newry Navigation Company are 4,000*l.* per annum; there was a crane at one time in Newry; there is no accommodation for a third steamer at Warrenpoint; there is no quayage at Newry.

Mr. **RAMSAY** here mentioned, that on the night of the great storm, in January, 1839, when there was so much damage done in every other harbour, there was no damage sustained in Carlingford harbour; he thought it right to mention this, as showing the security of Carlingford.

Captain **THOMPSON**.—There are 5*s.* paid each trip of the steamer for anchorage; there are two packets on this station now, and at one time there were three; the other one, the "Shamrock," has gone off, in consequence of her owner dying; the traffic has trebled during the last three years; almost every week we are obliged to leave goods behind which we cannot bring away; one week I had to leave a whole cargo behind; there is plenty of traffic for two additional steamers, if there were proper accommodation at Warrenpoint; it would be greatly to my advantage if I could run into Newry—that is, if the terminus of the Newry and Enniskillen Railway be in Newry; I could come up to Fatham, if I had permission from the agent; want of water from Fatham to Newry prevents me from running into this town; there is a want of quay at Fatham; I should think a timber quay could be erected at Fatham for 200*l.* or 300*l.*; I could save my tides the same from Fatham as from Warrenpoint; we would then come up within about two short English miles, or one good Irish mile, of the town of Newry, and at present we are six miles from it; there is no obstacle between Liverpool and Newry, except the bar in our bay; the Morne mountains are an excellent land-mark; Car-

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lingford is the safest place for communication between England and Ireland; the mails for the north, from London, could be delivered 12 hours earlier by Carlingford than by Dublin, and, by the Omagh and Londonderry Junction Line, the mails could be delivered in Derry three hours after reaching Newry; a steamer might come across from Liverpool in nine hours; I consider this harbour a better harbour than Belfast; in Belfast there is a mussel-bank, and a nasty rock called the New Rock; I would not take a vessel of my own, drawing 15 feet, up the new canal; the Black Rock at Omeath is an excellent breakwater, and nature has evidently designed there should be a dock there.

Captain **WATSON** said there were two feet less water at Omeath than Captain Thompson had stated; there were only seven feet of water; all the Liverpool vessels, he thought, could run into Carlingford Lough with a south wind.

Captain **MACKAY** examined.—I have been commanding a sailing vessel for these last 23 years, constantly coming into Newry, but I first came to the port in the year 1813; no improvements have been made on the port during that time; there is always sufficient water in the harbour, unless at the bar; the draught of my ship is 18 feet; I have been inconvenienced by waiting at the bar; if it were removed, it would be of great advantage to the whole world; the vessels trading up the Irish Channel come within 20 miles of Newry; vessels pass to the west of the Isle of Man; they keep close to the Irish shore; all the north and south trade pass within 20 miles, and all the Liverpool and Baltic also; I am of opinion a harbour of refuge is more necessary at Carlingford than at any other place; Carlingford could be made a refuge harbour by deepening the bar; in the course of 23 years' trading to this port, I only met with one accident; it was but a slight one. We have no branch pilots here, and there is a great want of them; there are, I should say, 4000 vessels, including wind-bound ones, come over the bar every year, and there is but one pilot who could be depended on.

Mr. **CARVILL**.—We have about 20 pilots who have received certificates.

Examination continued.—There are seven pilots who have certificates for the Bay of Carlingford, and 11 for the river, but they have undergone no regular examination; any man could run a vessel into Carlingford Harbour; I think the lights are sufficient, and the buoys and beacons are also sufficient; I have occasionally given foreign vessels a description of the place; if there were a few more feet of water at the bar, it would save a great deal of damage; if the bar were removed, Carlingford would be a better harbour than Kingstown, where my vessel was considerably injured; I would prefer coming into Carlingford Harbour without anchor or cable, than going into Kingstown Harbour with anchor and cable ready to drop; the risk would be less in coming into Carlingford; this is on account of the nature of the bottom, and the shelter afforded by Carlingford; I agree with Captain Thompson as to coming to Warrenpoint; if I came to Newry, I could discharge everything; docks at Omeath would be more convenient than at Warrenpoint; if the canal were deep enough, I would prefer coming up to Newry.

Captain **OWENS** here said that the water on the bar was always quite smooth.

Mr. **RAMSAY**, in answer to the Commissioner, said he calculated that the cost of removing the bar would be about 40,000*l*.

Mr. **CARVILL** said, he understood the making the banks of the new canal was injuring the river.

Mr. **RAMSAY**.—No.

Captain **THOMPSON** said, there was no difficulty, with a tug, in dragging a vessel through the channel.

WILLIAM HENRY BROAD examined.—I am chief of the Coast Guard at Cranfield Point; I was at sea for 12 years, sailing in active service; I have resided eight years on the shore; during that time I have seen many vessels taking refuge in Carlingford Harbour; if the bar were deepened it would be of great advantage; the vessels which were wrecked off Skerries might have been saved if the bar were deeper; Carlingford is the most desirable place for a harbour of refuge; it is superior to Dundrum; the pilots here are not sailors; they pass no examination; several accidents occurred from want of pilots.

Mr. **CARVILL** here said, that he knew a ship of 400 tons' register to come into Carlingford Harbour, instead of Dundalk, she having no water in Dundalk; he also mentioned the circumstance of a vessel which could not get into Dublin Harbour, being obliged to come into Carlingford.

Examination continued.—I knew the "Daisy" to be wrecked, and all hands lost on this shore, but there were several other wrecks in other parts of the bay; I knew four others: they were the "Diana," under the Waterhouse; the "Speedwell," on Cranfield Point; the "Clarence," on the Blockhouse; the "Mary" of Whitehaven, on the Long Rock; and also the "John Stamp," an East Indiaman: these vessels could have been saved, had there been deep water at the bar; I heard complaints of a want of lights.

Captain **WATSON** (having been requested by the Commissioner) stated, that he was mainly instrumental, at his own expense, for which he had never received a farthing of remuneration, in getting the lights at St. John's Point. In 1837, I met the late Lord Downshire, and had a conversation with him regarding the want of a light there; upon which he requested me to exert myself to get a light; and his lordship gave me an assurance that he would render me every assistance in his power, which he did. I then opened a correspondence on the subject, and forwarded memorials to the Ballast Board. The Ballast Board wished to have a light at Ardglass; I went to Belfast and several other places, and procured memorials; I then went to Liverpool, and thence to London, where I met Lord Downshire, who gave me an introduction to a gentleman who holds a seat in the Trinity Board, and they consented, in 1839, to erect it; but it was not till 1843 that the tower and light were erected; the wrecks in the neighbourhood were awful prior to the light being erected. The Trinity Board seemed to think the effect of the light would be to embarrass the mariners, but such was not the consequence; and not a vessel has been driven on shore since the light was erected. I never knew the London Trinity Board to refuse to erect a light when the Ballast Board advised it. For all the expense I was at, I never received a farthing of remuneration. Major Bailie advised me to keep copies of the correspondence, which I have done.

The **COMMISSIONER** said that Captain Watson's conduct reflected the highest credit upon him, and he could corroborate his statement, that since the light had been placed no wreck had occurred in Dundrum Bay.

The examination of **WILLIAM HENRY BROAD** continued.—From Soldier's Point to Cranfield Point, I think the rocks could be taken away, but great care would have to be taken in so doing; Carlingford

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should have a buoy; if it were buoyed, perched, and deepened, I would, as a seafaring man, take Carlingford before any other harbour; I agree, generally, with the opinions given to-day of Carlingford Harbour; I think if an inducement were held out to the pilots, there would be proper ones here; there are 15 registered fishing-vessels of the first class, 70 registered boats of the first class, and about 300 yawls; the fishing-ground is about 16 miles out; I have seen, in the herring season, from 200 to 300 boats out of Carlingford; the fishermen run into our harbour for refuge.

Lieutenant **SERVANTE** examined.—As to the change of lights alluded to by Captain Thompson, I think it should not be made; I live at Greenore; I commanded the "Shamrock" Revenue Cruiser; a harbour of refuge is essentially necessary at Carlingford; I can take Belfast at all times; deepening the bar would not be attended with much expense; if the bar were deepened the harbour would be invaluable.

Mr. J. H. **QUINN**, solicitor, here handed in a copy of the original patent of the Kilmorey and Anglesea estates, for the information and guidance of the Commissioner.

HENRY COFFEY examined.—I am a pilot here 27 years; I have seen many vessels coming up Carlingford Lough; I was appointed pilot by the Navigation Company; there are seven pilots here; we make an agreement for our payment, as the rates of pilotage are not enforced; there are no fixed rates of pilotage, and I think it is desirable there should; seven pilots, I think, would be sufficient.

Mr. **CARVILL**.—If you enforce pilotage, seven pilots would not be sufficient.

Examination of **HENRY COFFEY** continued.—I meant, when I said seven pilots, seven boats, with extra hands; the amount of pilotage should be raised; I think there should be larger perches and beacons in the harbour; I could give the Navigation Company advice where to put beacons, and I would undertake to keep them in order; there have been complaints about the bar; the bar should be removed; there are only nine feet water there sometimes, and there should be 20 feet always; a heavy sea breaks on the bar, with the tide running over, but I never knew a vessel to have her deck swept with it; we can come in when there are 15 feet of water; we know when there are 15 feet of water by the time the tide makes; I never heard complaints about the lights; it is very well to have a revolving light; the revolving light and the Hawlbowline light are not on the same level; the outer one is 130 feet high, and the other no more than 40 feet; I know other ports; I was a pilot on board the revenue cruizer "Prince of Wales;" the worst wind is the south-east wind, and that is the fair wind into Carlingford Lough; I have seen thirty or forty vessels run into our harbour in one day for refuge; if the bar were removed there could be no better harbour; I know the passage through the Narrows, and I think there would be danger bringing a vessel through them, as the tide runs rapid there; the tide runs between three and four knots an hour; it does not run at the Narrows so rapid as formerly; I have been up the Narrows several times these last two or three years, the race at Narrow-water is more rapid than at the bar; if the bar were deepened, there would scarcely be any wrecks; I knew of many wrecks at St. John's Point in consequence of the bar not being deepened; the vessel "Orissa," outward bound to Bombay from Liverpool, with a valuable cargo, would not have been wrecked, as she was, had there been sufficient water at the bar; I would think a channel should be deepened 4 cables' length in width.

To Captain **WATSON**.—I think if we had two smacks for the pilots, they would be much better than the small boats we now have. The witness instanced cases where vessels had been injured for the want of proper pilots.

Mr. **BOYD**, clerk to the Navigation Company, mentioned a case where improper pilots injured a vessel, and afterwards brought the master of her before the magistrates to compel him to pay them.

The **COMMISSIONER** said he thought the magistrates should compel the Navigation Company to have proper pilots.

Mr. **JENNINGS** explained that the Navigation Company did take great trouble in the matter; but the fact, he said, was that the Board did not take any cognizance below Warrenpoint.

Captain **OWENS** said he should like to see a strong current at the Narrows.

Mr. **RAMSAY** said—There was one peculiar fact connected with our port, and it was this, that, unlike other ports, what was dredged to-day we had not to dredge again to-morrow; and this circumstance made him feel satisfied that the bar, if once removed, would never fill up again.

Mr. **DAVID TODD** said he wished to mention one or two matters to the Commissioner. He said that, in 1836, the Navigation Company got a loan of £12,000 from Government at 4 per cent; and again in 1842 (as we understood), another loan of £20,000, for which 5 per cent. interest was charged. He had also a complaint against the Navigation Company, which was, that they permitted vessels which were bound to pay a charge of 1*s*. per ton, to unload at Warrenpoint their cargoes into lighters, which did not pay more than 4*d*. per ton. He thought that the rates should be assimilated.

Mr. **BOYD** said that the present Company levied the same rates which were paid when the former managers had the navigation under their control. He considered that when they pay the charge for having the cargo brought up by lighters, they should not be subjected to a heavier rate of tonnage than 4*d*.

Mr. **JAMES QUINN** then raised a discussion about the management of the affairs of the Navigation Company, in which Messrs. Carvill, Boyd, Jennings, Caraher, and others took a part.

The **COMMISSIONER**, having been informed that the contractor was not finishing his work within the appointed time, inquired if there were no summary way of dealing with him.

Mr. **JENNINGS** said that the power lay in the hands of Sir John Rennie; but that gentleman had assured the Company that the works should be completed within the appointed time.

Mr. **CARVILL** complained that in 14 years they had only got 2 miles of their canal formed.

No. 132.
Nimmo's Report on the Navigation.

No. 132.

The Report of ALEXANDER NIMMO, Esq., *respecting the Improvement of the Newry Navigation.*

SIR, *Dublin, Saturday, 30th August,* 1828.

After maturely considering the proposed design for extending the present Fatham Canal to the neighbourhood of Rice's Bay, or opposite to Warrenpoint, and examining the ground through which this extension is proposed to be carried, as also the present channel of the river of Newry from that town to Warrenpoint, and causing the necessary surveys, soundings, and borings to be made on the line of which I shall now proceed to treat, it appears to me—

That the extension of the canal to Rice's Bay, however desirable it may have at one time appeared, and though certainly an improvement on the present navigation, is neither so well suited to the present state of trade, nor so desirable for the commercial body of Newry, and the interest of the interior, as an improvement which I find to be practicable, at about the same expense, upon the existing bed of the river. In the plans for promoting the inland navigation of Ireland, the improvement of the channel up to Newry was an early object of attention with Parliament. It was necessary for completing the communication from the collieries of Tyrone to the city of Dublin, from which much benefit was then expected: and though in that respect it has been of little use (coals from Great Britain being now imported, in preference, into Lough Neagh), yet the benefit to the neighbouring country has been very great, and particularly to the town of Newry, which has been greatly enlarged in consequence, and become a seaport of importance.

The history of that improvement is interesting:—It appears, first, to have been attempted on the same principles as the cut for the river Dee, at Chester, viz., by making a new and straight course for the river, through the meadows, trusting to the streams for scouring and lowering the channel. The Newry navigation was made to terminate at the head of this cut by a ship lock, which converted the lower pond of the canal into a floating dock, for sea-going craft. The engineer employed was Mr. Golbourne, from Chester, who assisted in similar operations on the Boyne and Clyde. It does not appear, however, that there ever was or could be a sufficient body of water in the river to make any serious impression upon the channel. The meadows, which were overflowed at spring tides, were cut off by embankment; and as the powerful means which we now possess for deepening rivers was not then known, the result of this improvement was but feeble. Even the small vessels that frequented Newry must have been frequently neaped in the channel, which, having so little back water, was constantly deteriorating.

To avoid these inconveniences, the construction of the present canal to Fatham seems to have been resolved on. It is well calculated for the ordinary run of coasters, of about 100 to 120 tons, having nine feet water or a little better, and 21 feet breadth in the lock.

This canal is defective in having no enclosed tide basin below the lock; and as the sill or floor has unfortunately been laid so high that at some tides there is not so much water over it as in the canal, vessels are often neaped here. The small harbour below the lock is much choked with mud, and some shoals have formed in the channel, just below, which add to the obstructions of the navigation. It is probable that, at the time of its construction, there was deeper water in the channel, opposite to Fatham Lock, as the shoals are understood to have gradually extended down the river since that time: this seems to have been a ground of much alarm to the Directors-General, though it would certainly cost no great sum, at the present time, to remove all the obstructions arising from this cause.

But this is not the only inconvenience in the navigation: the channel speedily deepens after passing Fatham and Green Island, and, at the Doyle Hole, we have no less than 72 feet at low water. But as the channel is in the middle of the estuary, with a broad mud bank on each side, and no towing path, vessels are often stopped and baffled by sudden flaws of winds in the narrow glen. The depth in the Doyle Hole seems to be preserved by the overfall of the flood tide over the rocky shoals below —for, from the point called Rough Island, a rocky shoal passes over to the Squire's Point, and thence across again to the south side, making an intricate and winding channel, with four to six feet water; and, at Narrow-water Castle, a reef of rock extends completely across, with only three feet water in one narrow passage over it. All alluvial matter is washed off these shoals, and, for a considerable way below Narrow-water, and until the channel begins to widen near Warrenpoint, we have only gravel, stones, and clay, with some rock on the south shore—the depth of channel varying from three to five feet.

At this widening, a deposition, as might be expected, has taken place, and a broad shoal, or pit of sand, called the Scar, extends along the Louth side, pressing the deep-water channel to the Warrenpoint side, which is composed of gravel, and where we find six feet water, continuing out for a mile into the Lough, with mud and sand at bottom, on which the large vessels frequenting Newry lie at their moorings.

Warrenpoint is the most convenient landing-place for these vessels; it is within six and half (English) miles of Newry. To obtain a similar depth of water, on the opposite shore, would require piers of considerable extent to be carried out into the Lough; and as they would lie athwart the course of ebb and flood, it is probable that they would be very liable to be silted up. Unless this inconvenience should occur, however, they might be contrived to afford good shelter to vessels that could take the ground.

As already observed, the Fatham Canal being only fit for small coasters, such goods as timber, or what comes in large vessels, are necessarily brought up to Newry by small sailing craft; and, of course, with considerable expense and delay. The steam vessels which ply to Liverpool and elsewhere, land and ship at Warrenpoint. To remedy these difficulties is the object of the extension of the canal to Rice's Bay, and it should certainly, at least, go beyond the Scar. It does not, however, appear advisable to lay the entrance looking right down the Lough, as, with winds blowing from that direction, it would be very turbulent.

But, without entering into any observations on the detail of this canal, which I dare say has been very maturely considered and estimated, and the expense of which does not appear to me to be overrated—I shall only remark, in general,—

That the dimensions proposed being the same as in the present canal, of which indeed it is only an extension, it is evident that no other class of vessels can be brought up by it than come to Newry at present. The transhipment, therefore, from large vessels, must still go on as before, with the advantage, if thought proper, of having it done in a dock, and of landing these into stores and yards. The steamers, also, can take no advantage of it, without a very great enlargement of the lock, and a proportionate consumption of water, and addition to the expense; and it is to be observed, that even now there is a frequent scarcity of lockage water.

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The small craft and coasters will, however, have the advantage, at an expense of five miles more trackage, of escaping the chance of being neaped, or detained in the glen, by haffling winds.

It is evident that the establishment for the accommodation of the shipping trade at Warrenpoint will be abandoned, and those which will probably arise on the opposite shore will, from the narrow country behind, be less accessible or useful to the neighbourhood than on the shore of the county of Down. It has become a most desirable object, in places situated as Newry, especially since the invention of steam vessels has done away with most of the difficulties of river navigation, to bring up the large craft as near as possible to the town, and have no transhipping port below. At Glasgow, in particular, much has been done in this way of late, greatly to the convenience of the merchants, as well as the improvement of the local revenue of the port. 'Tis not many years since the barbour dues of Glasgow were only between 300*l.* and 400*l.* a-year; they now let for 18,000*l.*, simply by the additional depth that has been given to the river; and they are now busy in dredging down the channel by means of the steam-engine.

I do not find that it will be difficult to deepen the tide channel up to Newry to a far greater extent than has been done in Glasgow, much of it being already far deeper than is wanted, and the whole extent to be cut being but small. The stuff excavated will form an embankment, or towing-path, along the Doyle Hole, and up to the old bank; and the reclaimed land behind it will pay for some part of the expense.

I.—For this purpose I propose to dredge, by means of steam-engines, a passage from Warrenpoint, along shore, towards Narrow-water, through gravel, stones, and clay; to have six feet depth at low water of a 15 feet tide, 50 feet wide at bottom, and to face the banks with stone, which will cost,—

	£.	s.	d.	£.	s.	d.
The Excavation	24,488	8	0			
Paving the Slope	2,727	13	6			
	27,216	1	6			
Ten per cent. for Contingencies	2,721	12	2			
				29,937	13	8
II.—Continuing same cut to the river, past Narrow-water Castle, mostly in rock	12,585	12	0			
Contingencies, 10 per cent.	1,258	11	2			
				13,844	3	2
III.—A cut across the Squire's Point, into the Doyle Hole,—						
Excavation, gravel, and stone	9,098	18	0			
Paving bank	1,630	10	0			
	10,729	8	0			
Ten per cent.	1,072	18	9			
				11,802	6	9
IV.—Forming an embankment and towing-path, from Squire's Point, to join the old embankment above Fatham Lock	9,487	10	0			
Facing same with stone	3,643	4	0			
Dredging mud and sand in the channel	5,667	4	0			
	18,797	18	0			
Ten per cent.	1,879	15	10			
				20,677	13	10
(90 acres of land are gained by this embankment.)						
V.—Deepening and improving present channel, or Golbourne's Cut	8,858	13	4			
Ten per cent.	885	17	4			
				9,744	10	8
				86,006	8	1
Deduct, for 90 acres of land				4,500	0	0
Total, for the tideway				81,506	8	1
VI.—Tide-gates, and widening part of present canal, as a tide-basin	4,500	0	0			
New ship lock, 36 feet wide, below Dublin Bridge	8,000	0	0			
Deepening and widening the lower pond up to the salt-works, so as to give 14 feet water	3,093	0	0			
	15,593	0	0			
Ten per cent.	1,559	6	0			
				17,152	6	0
Total expense			£	98,658	14	1

Otherwise by Entering at Fatham.

	£.	s.	d.	£.	s.	d.
Deepening and widening the canal for 2,200 yards, so as to have 14 feet water down to Fatham	4,400	0	0			
Ten per cent.	440	0	0			
	4,840	0	0			
Expense of deepening Golbourne's Cut, as above	9,744	10	8			
				4,904	10	8—Saving
Total estimate			£	93,754	3	5

The new side-basin and lock will be same as before.

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To any person at all acquainted with trade, the advantages of this arrangement must be manifest. In the first place, as we make 14 feet depth of water all the way up to Newry, we can bring in vessels of 400 tons, even upon eight feet neaps—proportionally more at springs; and, indeed, any vessel which will admit of entering Carlingford Lough. The whole expense of transhipment will therefore be saved. The dispatch will be, at least, as great as by a canal—the trackage will be easier, being upon a broader expanse of water, and assisted, either way, by the tide. If the vessel be stopt by the way between the Tide-basin and the Lough, she may lay afloat in the Doyle Hole, or stop in any of the cuts, as safely as on the bank below Warrenpoint. The steam-vessels will come at once up to the town, without any obstruction from locks, and will lay afloat in the tide-basin. From the current through the lower cuts there can never be any dread of obstruction there: and as navigation, by the old channel, will never be attempted, a stone bridge may be laid across at the rock of Narrow-water, with a swivel across the cut, which will essentially facilitate the communication between the counties of Louth and Down. At same time, as the cut re-enters the river, neither side is cut off from the benefit of the navigation.

In considering the increased convenience which this measure will confer on the port of Newry, we are naturally led to inquire whether any improvement can be made in its connexions with the interior, especially on the Newry Canal to Lough Neagh, by means of which the lower navigation is supplied with water. Before the modern improvements on roads and wheel carriages, this navigation was of more value than it appears to be at the present time. Indeed it is now common to carry heavy goods, such as coals and timber, to Tanderagee and Armagh by land, instead of making use of the navigation. Though in summer it is somewhat scantily supplied with water, and liable to the interruption of the bar at the mouth of the Bann River, yet it is generally in good order, and so much better than the Lagan navigation, that from the low toll upon the corn, &c. &c., it ought to be the channel of export for most of the agricultural produce of the countries on Lough Neagh.

It cannot, however, be denied, that the greater part of that trade is now directed to Belfast, which, of course, enjoys also all the benefits of the return trade.

Now, it appears to me that this navigation is capable of a singular improvement, the effect of which would be of the greatest possible consequence, not only to the trade of Newry, but to all the country on Lough Neagh. The summit level of the canal is only 21 feet above the lake, and three miles long; the soil is mostly soft, much of it bog, and of little relative value. It would be a matter of no great expense or difficulty to cut it out, and to bring the surface level of Lough Neagh through the valley towards Newry, giving a supply of water to the canal, and our proposed lower navigation, that would be abundant and inexhaustible; saving also the passage of three locks on one side and four on the other. I should propose to bring that level on to the town, which the ground readily admits of. And thus the whole of the inland trade of Newry may be done without lockage at all, and the cut may be of such dimensions as to admit of steam-vessels, so as to excel any kind of land-carriage, even in expedition.

A slight improvement on the Lower Bann would extend this level navigation to Portglenone, 60 miles, in a straight line, from Newry. We could obtain a command of Lough Neagh, such as to run it down some feet in the end of summer, and to keep its winter rise to the present summer level, thus saving from being flooded 6,000 acres of land; and we would bring a water power into Newry of, say, one-sixth of the discharge of the lake, with 45 feet of fall, which I estimate at 3,000 horse-power—being more than that of all the steam-engines of Glasgow.

The reservoir covers 100,000 acres; and the value of such a power, in a sea-port, and in the midst of a rich, populous, and busily-manufacturing country, is not to be easily calculated—indeed the like is not to be found in Europe.

The communication with the lower canal could be done by four locks; and they should be such as the present sea-lock, so as to admit small coasters, which could cross the Channel, and pass the Forth and Clyde Canal—which would infallibly draw the whole of the corn and coal trade of the interior of Ulster through this navigation.

To Hugh Boyd, Esq.,
&c., &c., &c.

A. NIMMO.

No. 133.
Rennie's Report on the River and Harbour.

No. 133.

Report of JOHN RENNIE, Esq., *on the state of the River and Harbour of Newry.*

MY LORD,

London, 5th *April*, 1830.

In consequence of your Lordship's letter, of the 24th of November last, requesting me to examine the River and Harbour of Newry, in order to give my opinion as to the most proper plan for improving it, I proceeded thither on the 12th of December following, but found it necessary to obtain some additional information, which the late severe winter prevented me from receiving until recently. I now beg leave to report as follows:—

The chief impediments in the navigation between Newry and the sea arise from the obstructed state of the channel from Warrenpoint upwards, commencing with the former place. The channel lies between the dock and the sea; it then turns north-west, passing the Old Man shoal, upon which there are only 2 feet 6 inches at low water of spring tides; from thence it continues tolerably direct, by the Little Scar, as far as the lime-kiln, having generally from 3 to 6 feet at low water; here there is a small projecting bar, occasioned by the mouth of a torrent: from thence to the shoal called the Scotsman, the channel is crooked and irregular, having for the most part little more than 3 feet 6 inches deep at low water; from thence to Narrow-water Castle the channel deepens to about 8 feet. The bottom from Warrenpoint to this place is very irregular, being mostly composed of loose stones, sand, and gravel, and in some places rock. At Narrow-water Castle there is a decided bar or fall, having generally about 2 feet upon it at low water, but at times it is almost dry; it is moreover, extremely confined in width, being only 350 feet at high water, and 70 feet at low water: the bottom here is composed chiefly of rock and loose stones. Immediately above the fall the channel bends to the westward, and increases in width considerably, and in depth to 7 feet as far as Nun Island: here it turns almost at right angles to the west, and diminishes to 3 feet deep opposite to Squire's Point—from thence to Geljay Rock, at the entrance to Doyle's Hole, it improves in depth to 5 feet, although extremely crooked. At Doyle's Hole there are 78 feet at low water: the channel from thence upwards is direct to Fathom, and diminishes rapidly in depth until it reaches Fathom lock, where it is almost dry at low water. From

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Narrow-water Castle to Geljay Rock, the bottom is generally composed of loose stones, and in some places rock; and from thence upwards it is chiefly mud, sand, and gravel. At Fathom, the canal to Newry commences with a lock, and a small open tide basin. Fathom Lock is 128 feet long, and 22 feet wide in the clear, having its lower cill 16 feet 9 inches below the coping, or about 3 feet 6 inches below low water; the upper cill is 4 feet 3 inches higher: from thence to Dublin Bridge the canal is from 55 to 80 feet wide upon the average, and has 9 feet 6 inches of water; the banks are slight, and in many places require repair. The lock at Newry is 128 feet long, 24 feet wide; its upper cill is 10 feet 6 inches below the top water in the canal, and the lower cill is 12 feet 8 inches. From a table of tides taken by Mr. Aird on the 12th, 13th, 14th, 15th, and 16th of January last, during the strong north-easterly winds of that period, and three days after full moon, it appears that, on the 12th of January the tide rose 13 feet at Warrenpoint, and 9 feet 10 inches immediately below Narrow-water castle—8 feet 2 inches above the castle—7 feet 6 inches at Fathom lock—and 4 feet 7 inches at Newry bridge, being a greater rise of 3 feet 2 inches at Warrenpoint than at the bottom of the fall, or lower side of Narrow-water Castle—4 feet 10 inches more than above the castle—5 feet 6 inches more than at Fathom—and 8 feet 5 inches more than at Newry;—but the average of the five days gives 11 feet 11 inches at Warrenpoint—9 feet 4 inches at the lower side of Narrow-water Castle—8 feet 7 inches at the upper side—7 feet 7 inches at Fathom—and 4 feet 11 inches at Newry bridge;—being an average greater rise of 2 feet 7 inches at Warrenpoint than at the lower side of the castle, and 3 feet 4 inches at the upper side—4 feet 4 inches less at Fathom, and 7 feet less at Newry Bridge.

From the average of time of low water taken from the same table, it appears that it was low water at Warrenpoint 1 hour and 22 minutes earlier than at the upper side of Narrow-water Castle—and 2 hours and 7 minutes earlier than at Fathom—and nearly 4 hours earlier than at Newry. The result of these experiments (although, if taken at different periods, might vary considerably according to the winds, tides, and freshes on the river) is, nevertheless, sufficient to show the great irregularity which arises to the navigation in consequence of the obstructions above-mentioned—so that the large class of steam-boats, and vessels above 200 tons, are compelled to receive and deliver their cargoes at Warrenpoint, a distance of 6½ English miles from Newry, which adds considerably to the delay and expense of the different articles imported and exported, and consequently tends to retard materially the increasing prosperity of Newry and its vicinity.

To obviate these evils so manifest, two plans have been proposed: one to extend the present canal from Fathom lock to deep water at Rice's Bay—and the other to improve the present river course, by dredging and jetties, and by making a new tide channel on the east side of Narrow-water Castle, in order to avoid the rocks and shoals between Warrenpoint and Doyle's Hole.

With regard to the first—it may be observed, that the extension of the canal from Fathom to Rice's Bay would no doubt be attended with considerable improvement, and would enable vessels to take advantage of the increased depth of water and additional rise of tide, and thus proceed to and arrive from sea, with little or no interruption; but unless this canal (with its locks and entrance harbour) is to be constructed upon such a scale, so as to be capable of admitting steam-boats and vessels of the largest class, it would not be calculated to accommodate the increasing trade of the port of Newry, and a very considerable portion of the present inconvenience would still remain without a remedy. A canal of this description, with its entrance harbour, would cost the sum of 136,812*l.*, and would require at least three years for its execution; and until completed, there would be no mitigation of the present evils.

With regard to the second—the propriety of such a measure must necessarily depend upon the nature of the river, the materials forming its bed, and the practicability of removing the present obstructions, so as to obtain the desired improvement;—and, from the surveys that have been made, it appears that this may be effected. The next question which arises is, what is the most advisable mode of carrying this improvement into effect? The new channel proposed to be made on the east side of the river, between Narrow-water Castle and the shore to Warrenpoint, is not calculated to obtain the desired object: the great defect of the river, at this point, is the narrowness, irregularity, and crookedness of the channel—but this new channel, if made as proposed, would be more so, and from its being so narrow, there would be a risk of vessels being thrown athwart the stream, and liable to be wrecked. Under these circumstances, I am of opinion that it ought not to be made there, and I would propose the following plan:—

The chief obstruction at present exists at Narrow-water Castle, this, therefore, should be removed by lowering the rock immediately in front of the castle, which would give additional space for the navigation, and then, immediately opposite, a new channel, of sufficient dimensions as to width and depth at low water, should be made, as shown upon the accompanying plan: this important measure, if once well carried into effect, would admit the tide more readily upon the flood, and facilitate its discharge upon the ebb, and by producing an increased velocity, would tend materially to scour and increase the depth of the channel upwards—the other obstacles would become more apparent, and the remedies more readily applied. The obstructions between Narrow-water Castle and Doyle's Hole might be obviated, either by making a cut across the shoal at Squire's Point, or by removing the most prominent of the obstructions in the old channel.

From Doyle's Hole to Fathom no difficulty presents itself which might not be obviated by dredging, or by low water jetties to contract the channel, if the increased velocity of the current should prove insufficient. The present canal, from Fathom upwards, must either be enlarged and deepened, together with a new lock for large vessels, or else the old river channel may be adopted for a portion higher up, and a new lock made, somewhat above the present, to join the navigation; but, as the correct position of this lock will depend entirely upon the effect which will be produced between Squire's Point and Narrow-water Castle by the works proposed there, it may be deferred until these important works have been executed.

With regard to the channel below Narrow-water Castle, there are several obstructions—these may be considerably improved by dredging and removing the loose stones, and by the increased velocity of the tide, arising from the improvement above; and if found insufficient, the new tide channel, on the west side of the river, may be extended downwards, as circumstances hereafter shall render advisable;—this, therefore, should be deferred until the improvement between Squire's Point and Narrow-water Castle has been effected.

With regard to the expense of the several works above-mentioned, this will depend upon the extent to which it is required to carry the improvement. The principal works are the enlarging and deepening of the present canal, and providing a new lock and entrance, and making the new tide channels at Squire's Point and Narrow-water Castle, and removing some of the principal obstacles in the remainder

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of the channel. The expense of these will amount to 66,796*l*. When these works have been executed the principal difficulties will be overcome, and the remainder, such as confining the channel between the canal and Doyle's Hole, and the extension of the new channel from Narrow-water Castle to Warrenpoint, are works of comparatively minor importance: and if further improvement be required, it can be carried into effect hereafter, as circumstances may render advisable.

By pursuing the plan above-described, each operation will gradually succeed the other, and its advantages will become apparent: and when the scheme is completed, the navigation, up to the town of Newry, will be equal to the accommodation of steam-vessels and traders of the largest class required, and will be rendered as perfect as a navigation of this description is capable of being made.

Upon the whole, therefore, comparing the advantages of the two plans,—the improvement of the river navigation,—on account of its great economy and facility of execution, its gradual operation, and superior space, when finished—together with the expedition of the tide in transporting vessels,—renders it preferable to extending the present canal to Rice's Bay.

I have, &c.,
JOHN RENNIE.

The Right Honourable Lord Francis Leveson Gower,
&c. &c. &c.

No. 134.

Brownrigg, on the Port and River.

No. 134.

Report by J. BROWNRIGG, Esq., C.E., *on the Port and River of Newry.*

SIR,

Dublin, 24th May, 1830.

In obedience to the commands of the Board, I have read over Mr. Rennie's report on the present state of the harbours of Newry, and observed the remedies he has proposed for the impediments to the navigation, and for the general improvement of the harbour or river, from Warrenpoint up to the town—and observe he has fairly shown the difficulties and dangers to which large vessels are exposed in their progress upwards, through the rocky channel from Warrenpoint to the north of the Narrows at Narrow-water; and he proposes to deepen and widen the rocky channel,—to deepen, by dredging the river up from Doyle's Hole to Fathom, to build a new lock, on a large scale, and to widen and deepen the canal up to Newry; and estimates the whole, 66,796*l*.

I have also read Mr. Killaly's report. On a former occasion he proposed to carry a canal from Fathom, along the shore, to a situation opposite deep water at Warrenpoint, and come down into the harbour by a lock, and thus avoid the straight and danger of the rocks at Narrow-water Castle. At that time there was no idea of deepening the canal from Fathom up to the town.

Prior to this, a plan of greater extent had been suggested by Sir Thomas Page, namely, to carry a Canal from Fathom to Rice's Bay, and into the deep and safe anchorage in that place; which I think was estimated at 136,000*l*. At that period steam-vessels had not been thought of, and the canal then contemplated was by no means on so large and deep a plan as that now called for, and, of course, the estimate for that work would now be found very inadequate to so great an undertaking, and would probably exceed 150,000*l*.

The heavy expense of this grand improvement is the only consideration that induces me to give it up, and to turn my ideas to a less expensive remedy, for if something shall not be soon done, Newry will be lost. It is now ten years since I warned the Board of the approaching ruin of the harbour of Newry, its trade and inhabitants—and said, "if it were not protected, the harbour would not last fifty years." The public seem at last awakened to the danger, and now seek for the best advice and most rational means of preserving the trade, and improving the port and approach to the town of Newry. There are three plans now suggested, and the choice seems to be between two of them; and on giving them my serious consideration, I am of opinion that the last plan, suggested by Mr. Killaly, namely, to carry a canal from Fathom, along the shore to Rough Island, and construct a ship lock there, to come down into the deep water at Doyle's Hole, is the cheapest and safest—provided, also, that a part of Mr. Rennie's plan, viz., for opening and deepening the rocky passage at and above Narrow-water Castle, be adopted, and properly accomplished: this combination of the plans of the two engineers would, in my opinion, secure a safe and permanent navigation; but one plan will not succeed without the other, in both, the widening and deepening the canal, up from Fathom to Newry, is contemplated.

There are, however, some weighty considerations which none of the engineers appear to have bestowed a thought on. The first and greatest is the supply of water.

The magnificent lock and canal, intended to receive the largest class of steamers and other large vessels, now contemplated, would be a monument of folly and want of foresight, if you had not, nor could not possibly obtain a supply of water suitable to such a spacious establishment; and this object I earnestly recommend to have examined with the strictest investigation, not only by the engineers, but by the noblemen and gentlemen, promoters of this grand improvement; and sorry I am to say I fear they will find the country does not afford a supply of water adequate to such a canal and lock as are now talked of. I know Loughadigan or Lough Shark, the Cusher River, and the stream from Camlough, and have often witnessed the paucity of their supply, and the real insufficiency of water to support the present navigation in summer, under the strictest management; and there is nothing to look to in that country, in addition to their present supply, unless they can dam up the waters of Camlough in winter, and ascertain for certain if they could collect a body of water sufficient to support the summer trade, even with an establishment at the embouchure, and measure it out as may be required, similar to the supply for the head level of the canal of Languedoc. There is at present no certainty that even this would be adequate to their expenditure: besides, there are several mills on this water-course, and it will be incumbent on the Board to deal with the proprietors of these mills. The consumption of water in the new canal would be five times as great as the consumption in the present canal; on the passage of every vessel, the new lock would consume above four times the quantity of water that is now consumed by the same operation at Fathom, and the loss, by evaporation and leakage would be more than treble the present loss; let this point be well considered before the size of the lock and canal are definitively adopted.

The next object for the particular attention of the engineers is, the intended widening and deepening the present canal up to the town; they will find the widening impracticable for a considerable distance

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on the side next the river, the banks being narrow and slight, and on the other side, the bank is the high road from Newry to Carlingford, and, as such, belongs to the public; it is also an embankment, for a considerable length of way, more than a mile, with a deep back trench, which trench is also a water-course for leading the drainage of the lands to the great aqueduct under the canal; now this aqueduct will be found to be the greatest impediment of all to the deepening of the canal. It is situated about 3000 feet from the custom house, and at this point the deepening must terminate, unless they can turn the crown of the arch, which I suppose is impracticable. It is a deep syphon tunnel, and to this tunnel the drainage of all the streets and lanes of Ballybot and the west side of the town, and all the fields on that side of the canal, and the stream from Turner's Hill, which turns a mill at the Old Distillery, &c. &c., all are drawn into a point, and passed under the canal, into the river. It is plain this public drain cannot be stopped nor diverted, even for one day, and if you are obliged to make a new equeduct before you pull down the present one, the canal must be cut across, and the trade of Newry must be suspended during this most difficult operation, which will require much time and expense, and the assistance of a steam-engine.

As to obtaining deeper water in the canal, by raising the banks and filling water above the present level, I apprehend that cannot be done, without flooding the floors of the custom-house and the dwelling-houses and stores on the west side of the canal, and about the basin and Sugar Island, the water being already flowing out on the pavement in some places. The increase of depth of water must be obtained by sinking only. Another important object of consideration will be the construction of at least two turning bridges, or perhaps three, on a different principle from the present ones, very large and expensive, to which add the cost of temporary bridges for the public during the construction of the new ones; these will be found tedious works, and heavy items.

Perhaps the most serious consideration of all is to know what will be the length of time that Newry may be cut off from commerce with the world? How is trade to be carried on?—or by what means are the inhabitants to exist during the execution of sinking and widening the canal from Fathom up to the town—constructing a new and deeper aqueduct—erecting large bridges, &c.? The plans now contemplated will for an indefinite time separate Newry from the sea, and Newry from Carlingford, either by land or water.

These undertakings ought not to be adopted without due consideration, and perhaps the expense, and hazard, and uncertainty, may probably suggest to the gentlemen interested the prudent caution of contenting themselves with more moderate sized works; with providing for the admission of a smaller class of steamers and other vessels; and to be satisfied with a lock of less than 200 feet long in the chamber, and 50 feet wide in the gates; and a canal of less than 100 feet wide, and 13 feet deep.

In the mean time, while this great scheme is under discussion, and while materials are in preparation, I beg earnestly to recommend attention to the deepening by dredging, and to the preservation of the channel from the deep water up to the lock at Fathom, and to keep open by all means the navigation you have, and never let it be destroyed or neglected until every material, of every kind, shall be fully prepared and laid down in convenient situations for the execution of the proposed improvements in the shortest time possible, and, also, a certainty of sufficient funds being forthcoming promptly, without the danger of a stop in the middle of the work, to the ruin of the town and its inhabitants.

I am &c.,

J. BROWNRIGG.

To William Searight, Esq.,
&c., &c., &c.

No. 135.
Killaly's Report on the Port and Harbour.

No. 135.

Report of JOHN KILLALY, Esq., C.E., *on the Improvement of the Port and Harbour of Newry.*

SIR, *Dublin*, 10*th May*, 1830.

The Board having transmitted to me the report and plan of John Rennie, Esq., C.E., for the proposed improvements in the port and river of Newry, on which they desire that I should make such observations as my local knowledge upon the subject may enable me to offer, his Grace the Lord Lieutenant having referred those documents to them for their opinion,—

I beg to state, for the Board's information, that I have read over, with much attention, the report of Mr. Rennie, and maturely considered the plan to which it has reference. I have also read over the report, and examined the plan, of Mr. Engineer Nimmo, for improvements in the same river—from which, and from my own knowledge of the port and estuary, I have come to this conclusion:—That the accomplishment of the measures proposed by Mr. Rennie to be first attempted, namely, the enlargement of the present canal, and the constructing of a suitable lock and entrance,—the making of new tide channels at Squire's Point and Narrow-water Castle, as also the removal of some of the present obstacles in the remainder of the channel,—would, in themselves, confer a great benefit on the port of Newry.

I concur generally in the deductions drawn by Mr. Rennie from Mr. Aird's observation on the rise and run of the tides from Warrenpoint to Newry: I agree, also, to his proposition of first removing the obstacles which impede the free passage of the tide from Narrow-water Castle upwards, before any considerable expense is incurred in deepening the reach from Narrow-water to Warrenpoint; as I join in expecting, that the increased velocity of the tide of ebb, which must follow from the removal of these obstructions, will effect much in this way; and, besides, develop with accuracy what is left for art to accomplish. I am not, however, equally sanguine with him, that the increased rapidity of the tides will produce the same beneficial effects from Doyle's Hole upwards to Fathom Lock. The bed of the river in this reach consists of ooze, mud, and sand: there is no deep water above it to receive a deposit, in case the tide of flood shall set it in motion, nor is there any expansion in which the tide could accumulate, so as to make its outscour effective. I therefore apprehend, that the keeping open this reach would be attended with a great deal of expense; and that a tide basin for entering the new lock, at or near Fathom, would be subject to continual filling up. These objections, if deemed of sufficient consequence, in a pecuniary point of view, by the merchants of Newry, can be obviated by extending the Fathom canal to Doyle's Hole, at which point vessels of the largest class can lie afloat, and enter the intended canal, at all times of tide.

Other advantages, I conceive, would be derived from this extension. The run for vessels from Warrenpoint to this natural tide basin would be short; and if the improvements proposed by Mr.

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Rennie in that part of the river were effected, there would be no doubt of their making this lying-place with ease and certainty in every tide; whereas, if the run extend to Fathom, land floods and baffling winds may frequently subject all vessels, save steam-boats, to be neaped in the channel. I have no data, from Mr. Rennie's report or plan, whereon a correct idea can be formed of the sufficiency of his estimate for the proposed works: on this subject, therefore, I shall merely observe, that I estimate from my own notes the cost of enlarging the Fathom canal, and building a lock of sufficient dimensions, suited to the passing of steam-boats, with an enclosed tide basin, at 34,150*l.*; which, deducted from the amount of Mr. Rennie's estimate, 66,796*l.*, would leave 32,646*l.*, for deepening the channel from Fathom to Narrow-water Castle, and for the removing of some of the obstructions alluded to between that and Warrenpoint. Whether this balance will or will not cover the cost of those proposed works, I am not at present prepared to say: its judicious expenditure, however, must be productive of much good.

To enable the board to judge comparatively of the project of carrying the canal to Doyle's Hole, instead of terminating at Fathom, as proposed by Mr. Rennie, I subjoin an estimate of the expense—first premising, that, if my suggestion were adopted, no artificial basin would be required, nature here affording one with unequalled advantages:

Cost of enlarging canal from Newry to Fathom	£8,250
Extending do. from thence to Doyle's Hole	17,050
Entrance lock	15,400
Total	£40,700

which, deducted from Mr. Rennie's estimate, as above, would leave 26,096*l.* applicable to river works, from Doyle's Hole to Warrenpoint. Now, if we assume the cost of deepening the channel, from Doyle's Hole to Fathom, at the moderate sum of 7,000*l.*, even without taking into account the increased cost of maintenance, the extended canal will appear to leave rather a larger balance applicable to the river works than if it terminated at or near Fathom lock.

I remain, Sir, &c.,
JOHN KILLALY.

To William Searight, Esq.,
Secretary to the Board of Inland Navigation.

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No. 136.

Ramsay's Report on Carlingford Lough Bar.

Report of JOHN RAMSAY, Esq., C.E., *on the Bar of Carlingford Lough.*

15*th October*, 1835.

GENTLEMEN,—Having, according to your wish, visited, in July last, the bar at the entrance of the Carlingford Lough, and made the necessary survey and borings for the purpose of ascertaining its nature and capabilities of improvement, I would beg to submit the following report concerning it for your consideration:—

The bar extends the whole distance between Ballagan and Cranfield Points, at the entrance to Carlingford Lough. It is partly bounded on the north-west by a line of rocks from Hawl Bowling, on which the present tide and half-tide light-house stands, to the shore on the Ballagan side. It is divided, from its position, being nearly north and south, into the North and South Bar:—the North Bar being about one-third of the distance; the South, the remaining two-thirds. The latter, or South Bar, is so foul, with large stumbling stones, the soundings so shallow, and the passage to the Lough so choked with the above-mentioned rock, that it is only fit for boats. The channel, or entrance to the Lough, is by the North Bar, and between Hawl Bowling and the shore on the Cranfield side. This bar extends in length, in the direction of the Lough, nearly one-third of a mile, measuring from the line of three fathoms' water of low water of spring tides, inside the bar, to the line of three fathoms, outside of the same. The soundings of low water of spring tides are about nine feet; though no sooner is the bar crossed, than they deepen inside to five, six, nine, and fourteen fathoms; and outside, to five, six, and upwards. At high water of ordinary tides there is seventeen feet water, and twenty-six at springs.

After having sailed on the bar, my impression was, from seeing it almost surrounded by rocks, and the boat-hook striking so hard upon the stones covering the surface of the bottom, that it would be, as has hitherto been reported, "a solid vein of limestone rock," running from Cranfield Point to Ballagan Point. By persevering, however, some parts were found to yield, and appeared soft. This was thought to be a deposit of sand between the crevices of the rock. To be more certain of its nature, however, and being provided with boring apparatus, two boats were moored and lashed together, and the boring commenced between them. This process went on very favourably; and, after proceeding for about half-an-hour, the augur, which was several feet into the bottom of the bar, was raised, bringing up the full of the shell with it; which was a blue, pliant, fine-grained clay; the finer the further down; that at the surface being in part mixed with sand.

Having been so far successful, the whole bar was subjected to the same test, with equally satisfactory results. In no one instance, throughout the whole bar, was theee the least appearance of rock found. The surface of the bar was, moee or less, covered with loose, tumbling stones; some parts were, however, quite free from them.

The weather being moderate, and the water very smooth during several of the tides, the bottom was quite visible. The stones were distinct; the largest but of moderate size, and the sea-weeds growing in abundance upon them. The clay, which is naturally in layers, had every appearance of rock; but when the point of the boat-hook raised a small portion, it incorporated with the current water, and clouded it.

The borings were numerous, and averaged in depth from 18 to 23 feet below low water. The relative position of the most particular of those borings are laid down on the accompanying plan, marked thus ⊙; having the letters of the alphabet attached, and corresponding to the following description.

The borings marked A, B, E, J, N.—The surface was loose tumbling stones, cemented together by the clay. Below the stones was clay, partly mixed with sand, for about two feet six inches. The remainder of the bore was very fine clay, as per specimen. These borings averaged from 18 to 23 feet below low water.

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C, D, F, G, H, L.—Some of these borings the clay was to the very surface: others, for a few feet down, were coarse gravel, sand, and clay mixed, as per specimen. They all terminated in fine clay, and averaged from 18 to 20 feet below low water.

K, L, M, P, Q.—The surface was loose tumbling stones; and below these, coarse gravel for several feet. In the remainder of the boring, to the depth of from 18 to 20 feet below low water, there was so little admixture of clay, that the stuff was washed out of the augur before reaching the surface.

Morgan's Pladdy, the Little and Big Breast, and Helly Hunter, were also bored and sounded. These places were found to be composed of loose tumbling stones, coarse gravel, and clay lowermost. The clay is of the same nature as above-mentioned. The soundings of the former three were from eight to ten feet low water spring tides.

Helly Hunter lies in a south-east direction from the bar, at about one mile and three-quarters out at sea, the sounding is about six feet. The stones here are very large, but loose; and the clay to the very surface, of which you have a specimen.

Some of the stones were lifted from the bar; they are mostly of a good quality of limestone. Were these removed, the deepening of the bar would, to a certain extent, be effected by the current of the tides, which, during neaps, is about 3½ knots per hour, and 5¼ during springs. The clay is of a very fine quality, and capable of being made into articles for domestic use, of which the committee have had a specimen.

It is matter of regret, that so great and deep a basin of water as the Lough should have such a barrier at its entrance; a barrier, however, from what has been above stated, capable of improvement, and of deepening to any extent; so that the largest class of vessels might pass over it at all times of tide. When past this bar, the Lough is capacious, and a harbour of great safety, affording convenient and good anchorage, and is capable of containing any number of vessels of the largest description. The soundings immediately inside of the bar are, as above stated, not less than six fathoms, and average to ten fathoms, till past Greenore; from which point to considerably more than half-way to Warrenpoint, the soundings are not less than five fathoms. Throughout the whole of this distance, there is excellent anchorage and shelter. The remainder of the Lough, towards Warrenpoint and the Bay of Rosstrevor, is either of a sandy or muddy bottom, so that vessels can take the ground with perfect safety.

Were it not for the bar at the entrance of the Lough, which precludes the larger vessels from entering, except at or near high-water, it would be an invaluable place of retreat and safety for vessels taken in a storm. At present, there is no harbour for shelter between Dublin Bay and Belfast Lough; and were Carlingford Lough made accessible, at all times of tide, for the largest class of vessels, it would greatly benefit the shipping interest at large, the district in the immediate vicinity of the Lough, and might be the means of saving the crews and cargoes of many large and valuable vessels.

The entrance is, at present, provided with two light-houses; one of a tide and half-tide, at the very entrance; the other a revolving light at Greenore, a little up the Lough. There is also a large buoy at Helly Hunter, and several buoys and perches throughout the Lough. The bar is, at present, the only obstacle that prevents the Lough being a place for indiscriminate navigation.

I am, &c.,
JOHN RAMSAY.

To the Committee of the Newry Navigation Company.

DUNDALK.

No. 137.

Evidence taken on the 7th Oct., 1845.

No. 137.

PORT OF DUNDALK.

Examining Commissioner—Captain WASHINGTON, R.N. and F.R.S.

Present—Mr. STRATON, Agent to the Earl of RODEN, Captain PURCELL, R.N., Mr. TURNER, Mr. M'ALISTER, Sir JOHN MACNEILL, Mr. NEVILLE, Mr. BROWN, &c. &c.

Mr. BYRNE (clerk of the Harbour Commissioners) examined, and stated some matters connected with the manner in which the Harbour Commissioners (twenty-five in number) are elected; the accounts are audited by Mr. Ranson; the average income is about 1800*l.* a-year; this year it will most probably exceed 2000*l.*; during the last year 716 vessels arrived of 80,000 tons; the harbour debt is 16,650*l.*; it was borrowed at 5 per cent.; the money could not be borrowed at a lower rate.

The sum of 10,812*l.* was expended up to August last; the Act empowered the raising of 100,000*l.* in any manner. The Steam Company purchased a dredge for 3550*l.* and twenty punts costing 1820*l.* The salaries of the harbour officers are 312*l.*; the solicitor's bill for the Act was 1150*l.*

This amount is paid; the engineer's bill for the parliamentary survey was 650*l.*; the 350*l.* before alluded to includes the resident engineer's salary; the accounts of the Harbour Commissioners are regularly printed and distributed. The shipping of the port has increased very much these late years; has heard no complaints of the harbour.

Mr. JOHN LAWLESS examined.—Is harbour-master of the port of Dundalk, and connected with it for the last 25 years. Is a shipowner. In the former condition of the river it was very difficult for ships to get up, owing to the want of water and the river being so crooked; vessels drawing 11 or 12 feet formerly came up; a vessel drawing 16 feet has now come up. The improvements began in 1840; the river has been straightened since. The bar, some of the pilots say, has been deepened one or two feet. About a mile below the Point there was a mussel bank, and the people took the mussels, which paid them well; the sale of them became a regular trade; the traffic is now nearly over. The channel has been very much deepened, thanks to the mussel-diggers.

Captain PURCELL, R.N., remarked, that since this had been removed the place had not filled up.

Witness.—The soil at the bar is composed of sand and blue clay. The perches and beacons are placed in their proper stations; since it came under the present Board there have been no complaints. There are no harbour lights, and there are great complaints on this head; a floating light could be placed in the Bar Hole; there are from 8 to 10 feet low water on the bar. I believe the Harbour Commissioners contemplated applying to the Ballast Board for lights; a floating light would remain there under any gale. There is no reason that a light upon Mitchell's screw-piles might not be placed there, as in Fleetwood, Belfast, &c. Mr. M. when he was here said it would

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take 2000*l.* to erect one; the Belfast one cost 1800*l.*, and I think it should be erected here for the same sum. When the steamers go out at night, the Steam-boat Company are obliged to send a boat's crew to put up lights at a charge of 15*s.*; if the weather does not permit the boat to go out, the steamer must lie still. Foreign vessels coming here complain very much of the want of lights; they could not come in at night of course without lights, so that of necessity they generally lie out till daylight. In addition to the perches and beacons we have three splendid buoys as guides to the bar; one is 10 feet by 6, and cost 50*l.*; it was laid down by the Harbour Board.

Since I have been harbour-master there have been no wrecks in the port; there was one at Salterstown, six miles out.

Witness.—This wreck took place on the last day of October. The quay where the steamers lie is built about 14 years; it is private property. The dues are now 1*d.* per ton, and were formerly 2*d.*; they are paid by consent of shippers; none of them is given to the improvement of the harbour. The quays are private property.

Mr. STRATON.—When we applied for the Act, we were aware the quays were private property, and we got a clause in the bill of power to purchase them in three years; but we had not funds during that period, and so we must go to Parliament to have the clause renewed if we want to purchase them.

Witness.—Between the quays there are small docks, regular mud-traps, which should be filled up; there are from 14 to 15 inches of low water where the dredge has not been, but where it has, there are from three to four. The Board supplies all the ballast necessary at 1*s.* 2*d.* per ton. The soil that gathers there is lifted every other year, and made ballast of. There are about 4000 tons of mud lifted every alternate year; the annual rise is from 12 to 15 inches mud. There has been a most important enclosure wall built from the quays down the river. The traffic during the last five years has increased 20 per cent. There come two steamers three times weekly; one is 365 tons burthen, the other 600; the exports are horses, cows, pigs, sheep, butter, eggs, poultry, &c. &c.; the imports are coals, timber, slates, iron, tallow, tobacco, &c. If the small docks alluded to were filled up, the current of the water would keep the mud clear of the river. There was a weir across the river between the bridge and the quays, which was removed this season; there are some mill dams up the river; there is the weir of Barleyfield at Castletown Bridge, which however only obstructs the rising of the river a few inches; I am aware that the greater the fall, the better the scour of the river, also that it is illegal to have these weirs there. There has been very much talk of making Giles's Quay a safety harbour; there are 2 fathoms of water about a stone-throw off; it would be desirable to make a safety harbour there; vessels with 10 or 11 feet of water can take the bar with safety; the anchorage is exceedingly good; it is of blue clay; besides, there is good shelter; from east round to south is our bad wind; I have known a vessel to ride out a south-east gale with one anchor. There are the Castle Rocks; they are not buoyed.

Mr. TURNER said he had applied to Lloyd's on this matter, but was informed it was out their business.

Witness, in continuation.—There are scarcely 3 feet of water on this rock, which is at the entrance of the bar. There was no application made to the Ballast Board; it is the province of the Ballast Board of Dublin to place the buoys; there were some wrecks on this place, and at Dunany Point; the rocks ought certainly to be marked. There are 22 licensed pilots on the river; they are rather numerous; they are paid by their earnings; the Harbour Board receive the pilot dues, and charge 10 per cent. on them; the dues are regulated by Act of Parliament; the pilots go out beyond the bar. I have heard of vessels that could not get pilots; there is no regular smack for them to cruise about in; I bought one which they use at times; the pilots are licensed by the Board; there were two dismissed for taking the bar before the tide was high enough; that accident befel a vessel of my own, but there was no wreck, though there might have been loss of life. The captains recommend the pilots to the Commissioners.

JAMES M'ALISTER, Esq., Cambrickville, urged the propriety of making Cilea's Quay a harbour of refuge, not less in connection with the shipping of Dundalk than for the general purposes of the Channel trade. Any one who had seen it must feel struck with all that nature had done for it; and it would only require a small outlay to make it one of the safest harbours in Ireland. The late Lord Oriel (who was representative for this county, then the Hon. John Foster, and who was a man possessed of the greatest statistical information), expressed his surprise that such a matter had never been taken up. He (Mr. M'Alister) hoped the great advantages which were so apparent in this favoured point would not be neglected.

Captain HUTCHESON (of the *Dundalk* steamer) gave evidence of the improved state of the river for the last eight years, before which time the steamers could scarcely come up to the quays; at least, they never tried; now they came up to the town quays; the *Dundalk* is 250 feet long; we make the passages as regularly from the quays as we would from the Point; I have frequently made complaints to the Steam Company, as to the want of lights, and we are obliged to put up lights ourselves; a light at the bar would bring us over it; the other light would still be necessary; the river is tortuous, and it would still be necessary to have the perches lighted; there are about 6 inches of sand on the clay at the bar, which, were it removed, would not again gather; the traffic has latterly increased much. I would recommend the bar to be cleared away, and also the mussel-beds; there would be six dredges required to keep it clear; I don't know whether this would not be too great an expenditure for the funds of the port. I have served my time as a regular sailor.

I know the rocks at Duneany; I am of opinion there should be buoys there; if we had not the water at the bar, it would not enable us to sail sooner, if the place where we lie at the quays were so deepened as to float the steamer at low water. A light on the very bar is necessary; leading lights might be placed, which would bring the vessels up; we keep the mid channel the way up; there should be two small leading lights, and these lighted two hours before and after high water; a light at the bar would be necessary with these.

RICHARD NEEDHAM, Esq., resident engineer of the works, was next examined.—He detailed the improvements on the river which had been already made; some parts were so deepened as to leave 5 feet of water at low tides, others 8 feet; Sir John Macneill's intention was to deepen to the extent of 3⅓ feet, but seeing the state of the river he purposes making it 5 feet. It would be desirable to have the fullest possible scouring power of the water; when the tide is at half-ebb I find the greatest rush; we don't purpose deepening the river up to the bridge; if the weir at Castletown were removed, it would of course increase the scouring power; by our embankment we cut off about 40 acres; the average depth on this at high-water springs was 6 feet; the surface water thus shut out cannot have the effect of doing any harm to the bar; the fall of the river from the bridge to the bar is 11 feet 8 inches; the rise of tide at the bar is 16 feet, and 7 at the bridge; the channel is to be 150 feet wide at the quays and 300 at the Point. The dredge is capable of working in 16 feet water; it was built by Maxton of Leith; we pay 8*d*. per cubic yard for the mud raised; the dredges work across the river, raising 3 feet of mud each cross; steam dredging is the best cure for any harbour. I have lifted stuff 4 feet on the bar; the foundation is very hard; we were putting down a light, and with a weight of 20 cwt. we could make only a half-inch sink; a screw-pile could be fixed most securely. There are weirs placed above the bridge; the Board made an order that they should be removed; the rate of current is in some parts 3 knots, and in other parts 5 knots.

SIR JOHN MACNEILL, under whose directions the whole of the works were carried on, gave his opinion on the proposed plans—which he fully entered into, and, corroborating Mr. Needham's evidence, showed clearly the great capability of improvement of the port of Dundalk.

PATRICK NASEY, a pilot, gave an account of his occupation as pilot for 30 years, during which time great improvements had taken place. At one time he could not bring up a vessel drawing 11 feet; now he brings up vessels drawing 17 feet; for instance, he brought up the other day the *Prince George*, drawing 16 feet 5 inches, and last night he brought up the *James*, timber vessel, drawing 14 feet 6 inches. He then went into minute details, which it is unnecessary to enter into.

Mr. BROWN, of the Coast Guard, examined.—He stated that pilots very seldom go out when it is blowing hard; six or seven years ago a vessel was wrecked at Blackrock; there was a heavy gale from S.E., with very thick weather; the crew were saved; they were not drunk; another vessel went ashore at Giles's Quay about three years ago; could give no further account of her, as the Coast Guard did not board her; there was a heavy gale from S.E. A vessel was lost at Salterstown on 1st November last; she was from Limerick, loaded with oats, and bound to Liverpool; recollects that a brig ran over the bar after a schooner; if she had not seen the schooner, she would have been lost; it was blowing a heavy gale from S.E.; some vessels got aground on the bar, but were got off; thinks the best thing for the port would be to deepen the bar; has known vessels to get aground with pilots on board; the brig *Authorpe* got aground with a pilot on board, but got off again; kept observations on the tides during the month of August last which he produced; the trade is increasing fast; increased much within the last year; 25 foreign vessels arrived this year; thinks a small tug steamer would be of great advantage; the tug, when not otherwise employed, might be used in harrowing the channel; formerly vessels were very often detained between Soldier's Point and the quays; vessels drawing from 10 to 12 feet of water were frequently detained four or five days; has heard that a steamer was detained three weeks in the river.

Mr. TURNER here stated that the *Earl of Roden* steamer got aground in the river, and was detained three weeks. Such a thing could not happen now, the channel being straight and much deeper. Has known the steamer to leave the quays, and to be detained three weeks in the river, and part of her cargo to have been discharged before she could get off.

On one occasion he endeavoured to get the *Earl Roden* steamer out at night, and she got on the North Bull. It came on to blow hard in the morning and the vessel's bottom was nearly beaten out.

Mr. BROWN, in continuation—Thinks lights are very requisite, one light on the bar and another on the Point; the crews of all the vessels who were wrecked in the bay were saved.

Has heard it stated that Giles's Quay would answer as a harbour of refuge; knows the Castle Rock; a beacon would be required on it; a brig called the *Lady Anne* struck on it and sank; she was taken up some time afterwards; does not know the ledge of rocks off Dunany Point. There are only two first-class fishing smacks belonging to Dundalk Bay; there is a great number of fishing yawls at Blackrock and along Cooley shore.

EDMUND FINEGAN, examined.—Is a sloop master; his vessel belongs to Dundalk; has been 20 years trading to this port; his vessel draws 11 feet of water; two years ago he would have had great difficulty in bringing her up to the quay; would be often detained six or seven days in coming up, owing to the want of depth of water, and the intricacy of the channel; his vessel can now come up to the quays at neap tides as well as at springs; before the improvements he could not come up at neap tides at all. Trades chiefly to the Bristol Channel; great quantities of grain are exported from Dundalk; has frequently come over the bar at night; was obliged to light the perches himself, and frequently sent a boat with a light on it before the vessel; there is no difficulty in coming up to the quays; it would be desirable to have two leading lights; thinks the long avenue to be the best place for a light; or one light at the bar and another at the Rock or Tipping's quay; he took Dundalk Bar last winter as soon he could have taken Carlingford Bar; could not run his vessel over Carlingford Bar at less than two hours' flood, and could do the same at Dundalk Bar; hasn't known many wrecks in the Bay; he was wrecked himself at Annagassan; was riding under Dunany and the vessel dragged her anchor; she went ashore and was scuttled; has rid out gales at Dunany with one anchor ahead; the holding ground is very good in Dundalk Bay; there are more shoals on the north side than on the south side; has struck on the Castle Rock; had two pilots on board when the vessel struck; this occurred about 14 years ago; every Dundalk pilot is now able to take charge of any vessel; is not aware that the pilots passed an examination; when yawls can live in the sea, the pilots always come out; there are 22 licensed pilots; they are licensed by the Harbour Commissioners; the lights are the things wanted most; thinks a dock and floodgate would clear away the channel better than dredging; at Llanelly the channel is longer, and is kept clear by sluicing; at two and a half hours' flood tide, there are 14 feet water on the bar at Llanelly; the sluices are nine miles from the bar, and the channel is very crooked; there are about 4 feet on the bar at low water; thinks the bar would be dry at low water without the sluicing; Dundalk Bar is a shifting sand; has seen two channels over the bar; the south channel was the best one 20 years ago; it had been filling up gradually, but since the present improvements commenced, it was entirely filled up; no vessels came through it for the last 14 years; the north channel is better now than the south one was 20 years ago: the bar has deepened more than 3 feet since the improvements commenced; 14 years ago, the south channel began to fill up; there is no channel over the bar but one now; a boat drawing one foot could scarcely get over the bar at low

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Appendix B.

Dundalk.

No. 137.
Evidence taken on the 7th Oct., 1845.

water some time ago; cannot say what caused the north channel to break through; thinks if the bar was dredged that it would maintain its depth; the ridge outside breaks the sea from the bar; it extends from Dunany Point about a mile; heard of a vessel having struck on the ridge close to Dunany; there is no perch or beacon on it; he often sounded the bay in foggy weather; the soundings (depths) increase regularly from the south side; is of opinion that if a channel were dredged over the bar, it would maintain its depth; knows Giles's Quay; can't say that he heard that a harbour of refuge is wanted; was master of a vessel that would have been wrecked at the bay if her canvas had not been good; would take Dundalk Bar at night as soon as any bar on the coast if a light was on it; if money was laid out in deepening the bar and channel, it would be better than if laid out at Giles's Quay; knows vessels of 16 feet draft to have come up to the quays; nearly lost his vessel the last voyage, owing to the bad ballast; thinks a steam tug would be of use here; coasting vessels would employ a steam tug if the wind were foul; is always obliged to tow out at Llanelly; vessels always leave Dundalk Quays on the flood tide.

Mr. **Russell** tendered returns of trade prepared for the Parliamentary Committee of the present year, which might be strictly relied on as a correct report of the trade of the port of Dundalk: they show that the duties have trebled in the last five years.

He had nothing to add to the evidence already adduced with reference to the great improvements progressing in the harbour, and the general anxiety for a light at the bar, the necessity for which was daily becoming more urgent, in consequence of the rapid strides of the trade of Dundalk.

Captain **Purcell**, R.N., examined.—Would recommend lights to be placed, and an additional dredge to be employed; a steam tug also would be useful; thinks a depth of water might be maintained on the bar by dredging and harrowing occasionally; thinks the rocks in the bay ought to be perched and beaconed; is of opinion that it would be unfair to call upon the Harbour Commissioners of Dundalk to place beacons on the rocks; they have stretched a point already in placing buoys in the bay; agrees with Sir John Macneill that the Jetties outside would be very useful; doubts that a depth of 8 feet could be maintained over the bar at low water.

Mr. **Neville** remarked that, on looking at the map, it would be seen that the channel between the bridge and the bar was divided naturally into two reaches, the first terminating at the Soldiers' Point, where the tidal channel was much contracted, and the second at the bar. Within the first was principally deposited the debris brought down by the Castletown and Ballymascaulon rivers, of which the latter supplied the greater quantity; and in fact the minor bar formed at the mouth of the stream caused the second channel, now being cut off, near the Soldiers' Point; and to keep the channel open there and in the inner reach generally, would be more expensive than in the outer reach. The deposit in the reach lying between Soldiers' Point and the sea was made up of the lighter portion of the alluvium brought into the inner reach, but not deposited there, which floated outside the Soldiers' Point; and, from the fresh water holding the particles, floating on the salt water, being lighter, the alluvium was deposited over a wide space, and did little or no injury to the channel or the bar. The beach, which is washed along the coast and bay from Dunany and Annagasson, is stopped at Lurgangreen; and beyond this, little sand is washed that could increase the bar. The great cause of the bars at the mouth of the river is therefore removed by nature in this case; and there was little doubt but any improvement effected in the outer channel would be permanent.

No. 138.
Memorial of the Harbour Commissioners to the Ballast Board.

No. 138.

DUNDALK.

The Memorial of the Commissioners for Improving the Port and Harbour of Dundalk, to the Honourable the Corporation for Preserving and Improving the Port of Dublin,

Respectfully Showeth,

That your memorialists, since their appointment to the responsible office of Harbour Commissioners, under the 3rd and 4th of Victoria, have given their best attention to the necessary improvements of their port and harbour, and expended a sum of about 18,000*l.* under the guidance of their engineer, Sir John Macneill, and their port is likely, ere long, to rank highest along the coast between Dublin and Belfast.

The trade too is yearly increasing, 28 foreign vessels having arrived in the last year; a sum of 28,000*l.* received in the customs the year ending 5th January, 1844; 33,000*l.* in the year ending 5th January, 1845; and more than a corresponding increase has been realized for the year ending the 5th instant.

Your memorialists beg to draw the attention of your Honourable Board to a matter of vital importance to all vessels trading to this port, and also to vessels navigating the channel, which is not in their power to remedy, viz., the want of two suitable lights to guide vessels into the harbour at night. At present all sailing vessels are obliged to remain in the bay, exposed to any storm that may arise, and large vessels are sometimes neaped by the loss of the night's tide, and obliged to remain to the next springs.

The Steam-packet Company send men to light the perches for the accommodation of their own vessels, at the risk of the boatmen's lives, but in severe weather, when the lights are most required, they are unable to effect this.

Your memorialists might enumerate instances of danger and loss, were it necessary; but they forbear, considering the urgent necessity for such is so obvious that your Honourable Board will not hesitate to grant their request if at all in your power.

Your memorialists would refer, for a further proof of the great necessity that exists for such an object, to the Report of the Tidal Harbours Commission, where it appears, as the matter was investigated fully during its inquiry here.

Your memorialists pray your Honourable Board's serious and favourable attention to the above application.

Signed on behalf of the Harbour Commissioners now assembled
for this purpose,

John Townley, *Chairman.*

Board Room, Dundalk, 13*th Jan.* 1846.

Appendix B

Drogheda.

No. 139.

Evidence taken on the 8th Oct., 1845.

No. 139.

PORT OF DROGHEDA.—RIVER BOYNE.

Examining Commissioner, Captain Washington, R.N. and F.R.S.

Present:—Sir W. M. Somerville, M.P., Sir John Macneill, Ralph Smyth, Esq., Francis W. Leland, Esq., T. Brodigan, Esq., Thomas Carty, Esq., Patrick Boylan, Esq., William Cairnes, Esq., T. Grenoon, Esq., P. Beathen, Esq., H. B. Fairtlough, Esq., William Campbell, Esq. (Mayor), James M'Cann, Esq., John Maoee, Esq., John Shegog, Esq. &c., &c.

Mr. Appleyard (secretary to the Boyne Commissioners) handed in a list of their names, and answers to 120 printed queries furnished by the Commissioners:—

The average income of the Boyne Commissioners for the last three years was about 2000*l.*; he did not make up the annual accounts or the annual expenditure—the Board of Works did so; he laid the different accounts for expenditure before the Boyne Commissioners, who approved of them, and then submitted them to the Board of Works; the number of vessels arrived in this port for the year 1844 was—

Coastwise	931
Foreign	9
Total	940

The income of the Boyne Commissioners would be, he thought, this year 3000*l.*, and the expenditure 1000*l.*

Mr. Owens examined.—Is deputy harbour-master for this port; served his time to the sea; knows the harbour of Drogheda for the last 15 years; has seen great changes for the better since that time; 15 years ago vessels drawing 12 feet of water only could come in; vessels drawing 15 feet of water now can come up; 15 years ago, at low-water mark, there were only four feet of water at the bank called Colfore; now there are seven or eight feet; the increasing depth was got by dredging; there is a steam dredge on the river; there has been increased traffic to the port owing to the increased depth of the river; vessels of 300 tons burden now come up to the quay; witness's duty extends to the end of the ship quay; the quay has been lengthened since he was appointed; there are five steamers now belonging to the port; they make, on an average, eight trips each week; the bed of the river is of a gravelly nature, and never heard that it occasioned any damage to the vessel; the rings for fastening the vessels on the quay are not in good order; seldom attends the meetings of the Boyne Commissioners; any complaints he made were to the resident engineer; there are a few stones out of the quay wall; the stones do not fall into the river; the quay is not in good order; a quantity of stones on the south side have fallen into the river, and on that side there is very bad anchorage for ships, but made no complaint of it to the Harbour Commission; on the south quay vessels discharge bark, coal, iron, and ballast; there is a great inconvenience in discharging ballast from the south quay, as vessels have to remain 32 feet from the quay wall; ballast can be had for 6d. to 7d. per ton for rubbish, and at from 1s. 4d. to 1s. 6d. for limestone; heard no complaints for want of ballast; cannot tell the exact length of the quay; the largest steamer is about 200 feet long.

The Secretary.—The salary of harbour-master is 80*l.*; the deputy harbour-master 30*l.*; resident engineer 104*l.*; and two nightly watchmen at 26*l.* each a-year. Vessels cannot lie close to the quay wall.

Mr. Owens.—Thinks 2,160 feet the length of quayage; heard no complaint for want of berthage; if three steamers are in the river together, one lies abreast of the other; there would not be room for them to discharge on the south side; no ballast is thrown into the river; vessels do not always put up tarpaulins when shipping ballast; was appointed deputy harbour-master by Mr. Evans; the traffic has increased very much to the port since he became acquainted with it; has nothing to do with the pilots; the tide flows up the river nearly two miles.

Captain Morgan.—Is 23 years master of a vessel, and acquainted with this port; there is a great improvement in the river since that time; no vessel drawing 10 feet water could come up to the quay 20 years ago, unless at spring tides, and they might have to wait 10 days for the spring tides; now a vessel drawing 16 feet of water could come up; attributes the improvement in the depth of the river to walling and steam dredging; there are not four feet of water at the bar when the tide is out; at full tide there are from 12 to 14 feet; some years ago there was but one foot of water at the bar at low water; now there are four or five feet; the bar has been much improved by the dredging machine; at night the bar perch is almost invisible; there are three lights, one of them a guiding light; the bar shifts, and the lights are then altered; they are good lights; they have been placed there only three years; came into this port for 23 years without any lights; knew of several vessels being stranded for the want of lights; pilots meet vessels far beyond the bar.

Mr. R. Smyth here remarked that there was a vessel ashore at Bettystown at present.

Mr Morgan said that the captain of the vessel now stranded mistook the lights for the Dublin bar lights.

Mr. Smyth heard that such was not the case, but that there was no light on board, and that the master was not on deck when the vessel was stranded.

Mr. Morgan's examination continued.—Last winter several vessels went ashore at Balbriggan.

Mr. Baodigan.—In October last, 17 vessels were put ashore from Bray Head to Dunany Point.

Mr. Morgan.—There are perches wanted in the river; complained of want of perches to the engineer and harbour commissioners; they complained of the expenses; witness would wish to have the Carrick Bank taken away; vessels cannot take the bar in boisterous weather; frequently had to put into Kingstown Harbour; would advise larger perches to be put into the river, and they would be much better made of stone than timber; there are stone perches on the river Clyde; there are more mooring posts required; vessels from want of water have to lie 25 feet from the quay wall, causing a great expense for ropes, and very dangerous for persons going on board at night; the steam dredge on this river would not answer for deepening it at the quay wall; vessels cannot lie near the wall on the south side of the river; never saw the dredge working on the south side of the river, but she might be working there without his knowledge, as he was not always here; the rings, &c., are pretty fair on

Appendix B.

Drogheda.

No. 139.

Evidence taken on the 8th Oct., 1845.

the quay; vessels once moored, and the ropes across the river, are perfectly safe; vessels are safe from Maiden Tower up to the quay.

To Mr. Smyth.—It would be well to have posts on the quay, for in case of spring tides, if a vessel is going out, the rings are covered with water, and then the hawser has to be cut.

James Boylan examined.—Is a pilot; knows the port of Drogheda for 40 years; served his time to the sea both on yawls and sailing vessels; was 15 years on board of a sailing vessel; the bar was in a poor state 40 years ago; vessels drawing from 10 to 12 feet of water would have to wait from 10 to 12 days for a spring tide to come up; vessels, since the improvement in the harbour, drawing 15 feet, can ride up from the bar; there is nothing to prevent vessels drawing 15 feet of water at the spring tides running up the river; there are 53 pilots belonging to this port; is a first class pilot, and is authorised to pilot any vessel; there are also second class pilots for vessels not exceeding 80 tons' burthen; the pilots, previous to their appointment, are examined by four or five masters of vessels, and on a certificate from them apply to the Boyne Commissioners to be appointed; the bar shifts in southerly winds sometimes a cable's length; when the bar shifts, reports it to the other pilots and to the lighthouse men, who then shift the lights; saw the lighthouse-keepers sound the bar; the lighthouse keeper in rough weather must shift the lights by guess.

Mr. R. Smyth stated that it was his opinion that the Boyne Commissioners had no control over the lights; the Ballast Board in Dublin had the complete control. He, as a shipowner, having shares in 18 vessels and five steamers, was dissatisfied with the irresponsible shifting of the lights. It might be very dangerous to do so. For instance, the bar might shift in 12 hours, and it may be days before the pilots report it to the lighthouse-keepers.

The Commissioner expressed his extreme surprise that so important a charge as the shifting of the position of leading lights should be entrusted to an irresponsible person. Why not select one or more of the most able pilots of the port, and let them sound the bar regularly once a week, and after every gale of wind, and upon their report let the lights be regulated. This could be done at a very trifling expense, and might be the means of saving both life and property. And in addition to this, if it were found that the channel had so shifted that the lights in one would not lead in, a notice should be immediately printed and distributed. It would not be enough to placard it about the town, but it should be put into the hands of every shipmaster at the port, if it were really intended to do good, and not a mere matter of form.

Messrs. Carty, Jordan, Boylan, and several other shipowners expressed, their entire concurrence in Mr. Smyth's reply.

Mr. Boylan knows of no pilot being specially appointed to report the shifting of the bar; there are two or three perches wanted below Maiden Tower; wants more mooring points at Man-of-War Point; the river at Greenhills requires widening; the pilots live at the mouth of the harbour; in winter the pilots do not go to sea to meet vessels.

Mr. Smyth stated, the pilots were all fishermen, having yawls, and they have a great grievance to to complain of in trawlers coming and sweeping away their lines, buoys, &c.; he could not advise any remedy. He also stated that a safety harbour at Skerries would be very useful to the ports of Drogheda and Dundalk, and all along the coast; the bar at Drogheda is composed of drifting sand; the bar has never been deepened; the dredge has done some good.

Mr. Thomas Brodigan wished to remove some ambiguity in the evidence given relative to the harbour-master. Formerly the corporation, by royal commission, had the superintendence of the harbour; in 1827 it was deemed necessary to have a change in the management, which it was believed could be more advantageously entrusted to the mercantile gentlemen of the town, and an Act was procured by which some new men were introduced on the commission; Mr. Evans was appointed harbour-master, and the Act since obtained reserves to him his rights; but he (Mr. B.) had that gentleman's authority for stating that he was perfectly willing to retire, if a just and reasonable compensation was given him. He (Mr. B.) would recommend that this course should be adopted, as he thought it very desirable that an office of this important nature should be held by a nautical man; and he believed it likely that some retired naval officer would be found who would be glad to have 100*l.* a year added to his half-pay. In 1823 or 1824 he turned his attention to the state of the harbour; in many other seaports in which he had been, he had observed that steam dredging had been most advantageously used, and that it would be vastly for the benefit of this harbour that similar means should be here adopted instead of manual labour, then employed without much beneficial result. He suggested the matter to the gentlemen who had the superintendence of the harbour, but they had not the funds necessary for the purchase of a dredge. In 1827, however, he, with others, applied to Parliament and procured an Act, which increased their revenue, and the steam dredge now in use was purchased for about 5000*l.*, and from its use has followed chiefly the improvement in the harbour and the increase of trade that has been spoken of: the revenue at first was from 600*l.* to 700*l.* per year; last year it amounted to 2600*l.*, and this year it is expected to exceed 3000*l.*; in the half-year already past it has exceeded the receipts of the corresponding portion of the preceding year by 358*l.* It has been stated that the harbour commissioners are indebted to the Board of Works in a sum of about 10,000*l.*; he, for his part, had always felt the conduct of the Board of Works towards the commissioners to be such as he could not approve of. In consequence of a failure in paying a portion of the instalments, they foreclosed their mortgage, took the entire management of the revenues into their hands, and the commissioners can expend nothing without their consent; they seem anxious for nothing but the payment of the debt, and regardless of the improvement of the harbour. He had suggested to some of the commissioners the propriety of throwing off this incubus, as he thought that persons residing here, and interested in the commercial prosperity of the town, must be more competent to carry out the improvement of the harbour than any body of gentlemen residing in Dublin, however respectable they might be. With a view of freeing the commissioners from the Board of Works, he spoke to Mr. Barrington, the eminent solicitor, last week, as to the practicability of borrowing a sufficient sum of money for the purpose, and Mr. Barrington said he would have no difficulty in procuring for them a loan of 30,000*l.* at 4 per cent. per annum. Of this sum 10,000*l.* might be applied to pay off the debt, and the remainder vested in government securities, to be sold out as funds may be required for the improvements to be made under their own superintendence. To enable him to procure the money, Mr. Matthew Barrington merely wished to see the Act of Parliament authorising the Commissioners to borrow money on the security of the harbour. As to the re-payment, there would be no difficulty about it; they might either pay it back by instalments, or let it lie on payment of the interest. Mr. Barrington has already procured a loan of 60,000*l.* for the harbour of Limerick, and the securities which can be given by Drogheda harbour are equally good. An allusion had been made to Dundalk: he would mention that, through Sir John Macneill, money has been borrowed for the harbour there; the mercantile gentlemen of the town have the entire management in their own hands, and they are making vast improvements. The improvements here can be made at much less expense. Mr. Brodigan next referred to the obstructions of the force and volume of the current, which exist particularly at the bridge, which, with its large buttresses, choke up the stream, and cause the waters to be considerably higher on one side of the bridge than the other, to an extent of three or four feet, as was formerly observed in the case of the old London Bridge. Everything which obstructs the uniform and continuous flow of the volume of water takes away from its power to scour away the deposits; he would therefore suggest that the old fashioned pillars which block up the stream should be removed, and a new bridge thrown over in one span. There were other obstructions above the bridge which ought to be removed. "The great object we should have," said Mr. Brodigan, "is to cause nature to do the work of cleansing for us in Drogheda." Whilst on this subject, wished to know how far the rights of the Admiralty extend. He had seen an advertisement last week, purporting to be from Mr. Ball, offering to let land for building and other purposes, opposite his demesne wall, down to low-water mark; he thought if Mr. Ball had this power, it would materially interfere with the rights of the Harbour Commissioners.

Commissioner.—By Act 46 Geo. III., c. 153, the Queen has the power over all land from high to low-water mark, as far as the tide flows, and the right to it is exercised by the Admiralty for Her Majesty; and any persons making any embankments or other projections into the sea or river below high-water mark, without the consent of the Admiralty, are liable, by the said Act, to a penalty of 200*l.*

Mr. Brodigan considered this satisfactory on the point. He expressed his gratification at the prospect of improvements in the harbours of Skerries and Howth; in the former the proprietor was about to expend large sums of money for that purpose. He fully concurred in what had been said of the fitness of Skerries to be a harbour of refuge; with a comparatively small expenditure it would be decidedly the most suitable place for that purpose on the eastern coast. In 1828, when he was engaged in promoting the Dublin and Drogheda Railway, he induced Mr. Sutor to examine the harbour of Howth; an application was made to government for a sum of 400*l.* to improve it; and, although they were at the same time expending 500,000*l.* on another harbour, the paltry sum of 400*l.* or 500*l.* could not be procured for Howth, although, with a judicious expenditure of this sum, it could afterwards be kept properly dredged at an expense of 150*l.* per year, and this would enable colliers and vessels of a considerable draught of water to take refuge here.

Sir John Macneill said, in 1826 he made an accurate survey of the river, and a report. At that time there were from four to five feet water on the bar at low water, and believes the same depth has been maintained for a long time; there was a survey made so far back as 1782, by Golborne; since 1826 there has been no improvement made on the bar; it appears to have come to a certain height, and the currents have continued to flow with nearly the same power; the spur walls and jetties were erected by the direction of Mr. Baldwin, and seem to have produced a beneficial result at the time they were erected; Messrs. Bald and Nimmo also added some improvements by their directions to have longitudinal dykes along the river, which he (Sir John Macneill) does not think have been properly carried out; the channel should be made of a more uniform width; the spurs, he thinks, ought to be removed, as they obstruct the tide in coming out, and thereby lessen its scouring power and cause eddies; the removal, he thinks, should be done by contract instead of day's labour, as more economical and better work; the stuff removed, with stone rubble, would be available in completing the longitudinal dykes so as to make the channel uniform. The remaining portion of the stones might be carried down to the North Bull, where they could be serviceably placed, and at a little expense a great deal of sand might be carried out by the tide; the greater works on the North and South Bull could not be attempted until they were nearly out of debt, or had funds, as, once commenced, they must be carried on spiritedly; walls should be then erected on the north and south side; at present, he believes, that nothing but the large size of the estuary keeps the harbour so well as it is; this might be done something like the Dutch dykes.

John Young, resident engineer, examined.—Has been here as engineer twelve years; when he came here the depth was about 10 feet, and three feet at low water; it was Mr. Baldwin who proposed to have the parallel walls; the jetties or spurs were placed by Mr. Baldwin in 1783; when he came here 50 years after, he did not find that these latter were of any great advantage; the dredge which is at present in use is a 16-horse power, having 33 scouring buckets placed amidships on a ladder of 50 feet; it cost 4,500*l.*, and she moves propelling herself by paddles; she is worked up and down stream; has heard that across is best, but cannot work her so, as the current runs strong—in some places three, four, and five miles an hour; raises 400 tons of stuff per day, at a cost of about 3*d.* per ton, including the depositing; the stuff is deposited behind the parallel wall, but not above high-water mark; a portion of it does fall back in the channel.

Commissioner.—Then there is so much money thrown into the river. Why not do the work effectually at once? Have 20 punts, and let the 14 additional be of iron; they need not cost above 50*l.* a-piece.

Mr. Smyth explained, that there are but six or seven punts attending the dredge, and they can only work between tides; to do it properly they should have 20 punts, and we could not buy a punt nor a ton of coal without leave of the Board of Works.

Examination resumed.—A second steam dredge would be required; there would be less dredging required if the parallel walls were built; thinks it would be better to embank the lower part of the slobs, but not the upper; the bridge is an obstruction; it is too narrow; does not know anything of the obstacles above the bridge; did not think the Act gave any control to the commissioners over that part.

[On the examination of the Act, it appeared that all the rights of the Crown are reserved and guarded, so that they have power as far as the tide flows.]

Examination resumed.—There is a fall of four feet from the bridge to the bar; the tide does not rise as high at the bridge as at the bar; there is about 45 minutes' difference in the time of high water at the bar and at the bridge.

APPENDIX B.

DROGHEDA.

No. 139.

Evidance taken on the 8th Oct., 1845.

COMMISSIONER.—That is a decisive proof that there is something wrong in the channel; in so short a distance high water should be in both places almost simultaneously; there should certainly not be more than five minutes' difference. The Commissioner here illustrated the best mode of dredging, showing that it should be done so as to have the bottom and sides nearly rectangular, instead of dedging in a manner to leave the bed of the river a flat curve.

WITNESS.—If the dykes were completed, a beneficial result would be had at the bar; a harrow drawn after a tug would be useful to loosen the sand, so that it might be carried off by the tide.

The COMMISSIONER suggested that a steam tug-boat should be procured; even to private individuals or a company he thought it would be a profitable speculation; it should be frequently employed by the commissioners in towing punts, in dragging a harrow, and by captains of vessels to tow their vessels in and out, and by pleasure parties during the summer months.

CAPTAIN WHITE.—Is master of a vessel 13 years; since he first became master a great improvement has taken place in the Drogheda harbour; there is an increase in depth of two feet of water in the harbour; the steamer he is master of is 200 feet long, and draws 10 feet of water

Mr. MORGAN examined.—Is chief boatman of coast guard at Queensborough for the last seven years; since he first came here the river has a greater depth of water; the steamers, when he came here, had to go down to the North Crook to load, but now they load at the quays; boards all the vessels coming in; keeps a register, and the increase of arrivals is considerable; almost every night in the year passes over the bar; there is no difficulty in a vessel drawing 15 feet coming up at high water.

[The South Quay, which, from the evidence above given, appears to be in a very dilapidated state, only came into the jurisdiction of the Harbour Commissioners when the late Act passed. They set about the repairs (which are now almost complete) as soon as they received permission from the Board of Public Works.

The reason of the debt being incurred with the Board of Works was owing to a disappointment in getting an Act of Parliament, by which the Harbour Commissioners lost upwards of 3000*l.*]

No. 140.

Golborne, on the River and Harbour.

No. 140.

Report of JOHN GOLBORNE, Esq., C.E., *on the river Boyne and Harbour of Drogheda.*

Chester, 3rd May, 1783.

PURSUANT to an order of the Committee for improving the navigation of the river Boyne between Drogheda and the sea, I have examined that river and find many shoals in it. By the best information, am told that common spring tides flow eleven, and neap seven feet on the bar; that the spring tides ebb out two feet and half lower than the neap tides, and that there is about four feet on the bar at spring tides.

Half a mile from the bar-perch lies a parcel of large loose stones and gravel, called "The Loose Ground," part of which ebbs dry in spring tides, and I am informed there is about a foot and a half water in the best of the channel; so that vessels coming from sea when it blows hard are stopped there, lie in a very heavy sea, and are sometimes injured before there is water enough to carry them over it. The next impediment to navigation, is a bar of hard gravel below the bend at the Mussel-bank, where we sounded four feet with a very narrow channel. From thence to North Crook we found from six to eight feet of water, and on the Swash ford from three to four feet. New Deep has a very uneven bottom, and is from eight to four feet and a half deep. In the bight below Banktown-ford, we sounded ten feet of water, but immediately above it the channel becomes very wide, with a bed of hard gravel at the bottom, which, the current being unable to remove it, has got in breadth what is wanting in depth, to the great obstruction of navigation, as there are scarcely two feet of water over it. Here a number of vessels lie aground, waiting for the spring tides to carry them up to Drogheda. Hence to Queensborough Point, the river is in the state of nature, and having been suffered to make different channels, the ebb has been thereby so weakened as not to be able to wear it down to a proper depth. Opposite to Queensborough is a bank of hard gravel, over which there are two feet and a half of water; near to Queensborough Point, the hull of a vessel has been sunk with an intent to improve the navigation; but the current having been suffered to make a channel between her and the river, much of the ebb tide runs through it, to the great detriment of navigation. Under Beaulieu-house is a ford which has not more than two feet water on it: here the river has been suffered to become too wide, and the stone-work and piles having sunk down must be raised again with stones and faggots; for when the channel becomes confined, the bottom being of soft sand, will be soon deepened by the reflowing current. The jetty of stones must be continued from the ends of the pilework to the shore, and the water which comes through Beaulieu-bridge must be turned into the river at the angle where the piles turn towards the shore.

There is a shoal near Stameen-point which has risen from the same cause as Beaulieu-ford, and which consequently requires the same treatment. It will be necessary to extend a jetty from the line of the pile-work to the shore, in order to prevent the ebb tide from running towards Beaulieu-bridge. I observe a stream of water which comes from Greenhill; over this a bridge ought to be built, and a road made at a proper distance parallel to the river, by which means vessels might be towed up with horses when the wind is not fair. A jetty should also be extended from Elliot's wall to low water, and also one made on the opposite side, from low water mark to the shore. This would effectually force away any sand which shall be lodged there. Several jetties are also necessary for confining the channel in due bounds, which I have numbered on the plan and also in the estimate, to which I beg leave to refer. By an observation which I made on the tide, I find a fall of three feet two inches from the turning perch to the quay of Drogheda, in neap tides; I have before observed that the spring tides ebb two feet and a half lower than the neaps, which, added to three feet two, make five feet eight inches, and we have known from experience that water will move with a brisk current having three inches' descent in a mile. The river Ouse, which discharges itself into the sea below Lynn, in Norfolk, has but one foot of fall, from Denver-sluice to Evan-brink, in the course of 11 miles. Five miles from the bridge to the bar; let us allow three inches' descent per mile, which makes 15 inches; this deducted from five feet eight inches, four feet five inches remain, but for the sake of whole numbers let us call it four feet, and so much may the surface of low water be lowered at the quay of Drogheda in spring tides. The river Clyde, which I deepened, was 11 miles long, and had

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No. 140.
Golborne, on the River and Harbour.

but five feet six inches' fall in that distance. I lowered the surface of low water at the quay full two feet, and gave them seven feet of water in neap tides, where formerly no tide was perceptible at low neaps.

The river Boyne, having its source at a considerable distance, pours down great quantities of water in winter, which continues for a long time; indeed the depth of the river at the quay shows it, for all the vessels lie afloat, and there can be no doubt of deepening it, so to have six feet in every part of it at low water; so that every vessel which can come over the bar may, if the wind be fair, proceed directly up to Drogheda, when the several channels are collected, the fords removed, and a deep channel cut through the loose ground, by removing the stones which lie in the bottom to the sides of the river, where they will form a breastwork to confine the channel, which is at present much too wide; the ebb coming down in greater force may more probably mend the bar.

JOHN GOLBORNE.

SKERRIES.

No. 141.
Evidence taken on the 9th Oct., 1845.

No. 141.

SKERRIES HARBOUR.

Examining Commissioner—Captain WASHINGTON, R.N., F.R.S.

Present—J. JOHNSTONE, Esq., Agent to Mr. Hamilton; Mr. G. C. JONES, of the Coast Guard; Mr. J. GOWAN; JAMES DARHAM; W. GRIFFIN; and a number of pilots and fishermen.

MR. C. JONES, Coast Guard Officer.—Has been stationed at Skerries five months. Is well acquainted with the east coast of Ireland. About 30 vessels during the five summer months have anchored in the roadstead in easterly and south-easterly gales. Holding ground is said to be good. Never saw a vessel drive from her anchors here, and on the 2nd of October last it blew a south-east gale for some hours. Ballast is constantly thrown over into the harbour. Not aware of there being any harbour-master; but some one is said to do the duty.

Mr. JAMES GOWAN.—Has been 40 years at sea, and 72 years acquainted with Skerries. The old pier was built with public money, and extended as far as the present pier, that is, 140 yards. First grant, of 2000*l.*, in 1755; second, of 1500*l.*, in 1767. That fell into decay; and the present pier is a top-facing of rough stone raised on the old foundation by Mr. Hamilton. No toll was levied, but 6*l.* on each vessel was paid in 1776. Since then 4*l.* per vessel has been paid. A law-suit took place between the late proprietor and John Hore, which the latter gained. Could not compel any toll, and it fell into disuse. In 1834 the compromise was 30*s.*; and a paper was drawn up, stating that on paying 30*s.* a year for three years the harbour was to be kept clean. Money was paid generally—there might be some defaulters—but the harbour was not kept clean. Vessels continued to throw out ballast into the harbour; even the Skerries boats did so. Has seen ballast thrown out at the pier-head. Has often complained to the harbour-master, but no notice was taken of his complaints. Remembers that 15 years ago vessels could come close up to the wall; now cannot come near it. Told both harbour-masters on one occasion that a vessel was throwing out ballast. All agree that the stone-boats throw out ballast both night and day. It is commonly thrown outside the buoys. Between March and October 500 stone-boats, of about 15 tons each, come for limestone; they all cast their ballast, and allowing 4 tons each, this would make 2000 tons of ballast thrown over every year.

JAMES TRAGAN.—Only on Sunday last pointed out to the coast-guard man that a vessel was throwing out her ballast. Has seen carts take sand and stones out of the harbour, and some rocks even blasted, but not one-fiftieth part was removed of that which was thrown in: it has certainly become shallower. The pier affords good shelter as far as it goes; has good mooring-rings and posts, and is much better than the old pier. A far larger harbour is wanted; it will not contain even the vessels that belong to it. Has counted 25 sail in the roadstead in a south-east gale, and never saw a vessel drag her anchor, unless she anchored on the ground on which ballast had been thrown over. Even if she broke adrift she might run on the sand with safety to the people. Wind occasionally shifts from south-east to east and north-east, and this causes the damage. Thirty years ago many vessels were wrecked; this pier saved several. In fact vessels cannot be said to be wrecked here, as they are safe on the strand or behind the pier.

JAMES DARHAM.—Has been 33 years master of a vessel of 60 tons trading to Liverpool, carrying fish, potatoes, and corn, and bringing back coal. Merchants will not allow their vessels to anchor in Skerries, owing to the want of a harbour of refuge. Remembers the wreck of the *Acheron* of Workington. In 1844 the *Rose Bank*, in an easterly gale, came in at low water, ran on the beach, and was saved. The *Shannon* of Whitehaven, from Dublin in ballast, was lost just to the northward of the Carjee rocks, and a harbour here might have saved her. Great complaints of want of charts and plain sailing directions: the Admiralty charts are quite unknown. The *Earl of Gower* stranded at Balbriggan, three and a half miles to the northward; might have been saved here, but did not know it. The *Emily* also, and the *Romeo* for Calcutta, went on St. Patrick's Island on the 7th of February, 1843. Also in 1839 the *Rowena* of Belfast, and *Volusia* of Salcombe, were wrecked on Colt Island, with wind at south-south-east, which, had there been a harbour at Skerries, would probably have been saved. If a harbour should be built, a light would be wanted on St. Patrick's Isle, one mile to the eastward. Complains that the burning of coke near Balbriggan, for the use of the railway, might deceive vessels by night, as its light and Balbriggan pier light have often been taken for the two lights of Drogheda. Rockabil, three and a half miles to the eastward, is so bold it does not need a light. Current is not strong, about three miles an hour on springs.

WM. MAY.—Agrees in the statement heard to day. Also understood that the agreement made was for three years, and that the harbour was to be kept clear. All are of opinion that the harbour and roadstead are shallower than they were formerly. Recollects three schooners being ballasted out of the harbour.

WM. GRIFFIN, Harbour-master.—A bank has formed at foot of quay, owing to stone being dropped over in shipping it. The only complaint made to him was remedied. The waves have made an encroachment on the sea wall, and ballast was put there below high water to break the force of the sea; not only was it sanctioned, but a buoy was placed to cause ballast to be thrown between high and low water mark. A small island is forming in consequence. No bye-laws for the regulation of the harbour are printed and put up, nor a table of dues. The bay affords good

Appendix B.

Skerries.

No. 141.
Evidence taken on the 9th Oct., 1845.

shelter in south-west gales, and round to south-south-east, and is excellent holding ground. On one occasion the *Intrepid* broke her windlass, slipped, and ran on the beach, and her anchor afterwards could hardly be weighed. A fortnight since, in a south-east gale, counted 16 vessels in the bay. On the 4th October last 14 colliers, bound to the southward, lay-to in the bay with a flood tide, blowing hard at south-south-east. Drogheda vessels also come to wait for water over the bar. As many as 500 vessels annually stop in the bay. There are 45 first-class fishing vessels, and 70 yawls belonging to the harbour. Coasting vessels trade in potatoes, stone, and coal. 45 vessels pay 30*s*. each yearly, otherwise the dues are 2*d*. a ton for loading or discharging, and 1*d*. a ton for wind-bound vessels. 500 stone-boats of 15 tons each call in the course of the summer. Much more space is wanted in the harbour; there is not room enough for the fishermen, much less for any one else.

Michael M'Donough.—In 1841 even the fishermen of Skerries, in self-defence, summoned a Wicklow man to the Petty Sessions for throwing over ballast. The heaps of ballast on the shore would break a vessel's back. Formerly the fishermen loaded fish into cars alongside, which are now prevented by heaps of ballast from coming down on the shore.

Matthew Harlow, Coast-Guard man.—Five years resident at Skerries. Confirms all he has heard to day respecting ballast and the piers. Is of opinion that the bay affords excellent shelter in southerly gales. Has commonly seen 20 vessels seek shelter in the bay, and thinks that 50 have done so during the last five summer months. In November, 1843, counted 60 vessels at once seeking shelter in a south-south-west gale between Skerries and Balbriggan.

[The design for an extension of the pier, laid on the table, shows a rubble stone wall, with a long slope springing from the back of the present pier, and extending in a general north direction, slightly curving to the westward over the Cross Rocks: its whole length 600 yards.]

Rush.

No. 142.
Evidence taken on the 9th Oct., 1845.

No. 142.

RUSH.

Examining Commissioner—Captain Washington, R.N. and F.R.S.

Present:—Sir Roger Palmer, Bart.; Mr. D. Bastable; Dr. Greaves; Lieut. Senior, R.N., of the Coast Guard; Mr. J. Hoare; Mr. Workman, and Mr. T. Carey.

Mr. T. Carey, resident agent to Sir Roger Palmer, and a shipowner, has long taken great interest in the harbour of Rush. The pier was originally built by the Duke of Ormond, in the time of James II., and the present proprietor claims the royalties, 1*d*. a-ton, for anchorage and discharging. It is now quite unfit for trading vessels; three years ago a vessel of 144 tons discharged, but the harbour has since filled up with sand, and is now unfit even for fishing-smacks, and dries out some distance beyond the pier at low water. In 1837 the sum of 300*l*. was expended in cleansing the harbour and repairing the pier, and 40*l*. more in 1843, whereby 5 feet depth was gained, but it filled up again. Not 1*l*. a-year now received as dues; formerly, 40 fishing vessels of a better class belonged to the place, but they were driven away by the bad state of the harbour; the population of the town is 3,000, a large portion of which is dependent upon fishing, and consequently is in a great state of poverty. There appears to be a site for a deep-water harbour just to the northward in the bay, where two ledges of rock form a natural foundation for piers; rough slabs of limestone of large size abound on the coast, and would be easily quarried. The wreck of the "Mary," from Sierra Leone to Liverpool, in October, 1844, with a valuable cargo of oil, came ashore just to the northward of the Point, and the master and two of the crew were drowned. Two years since a sloop was wrecked near Lough Shinny.

John Flinn, Harbour-master, 60 years resident, remembers the harbour 40 years ago; had 13 feet in it at high-water, but thinks the sea has encroached on the shore, and washed the sand within the pier. The Rush fishermen are now obliged to resort to Howth and Skerries, where they sell their fish at a great disadvantage, and their families and their native place are deprived of their earnings. Is of opinion that a harbour is much wanted; that it would be the greatest benefit that could be conferred on this part of the coast; and thinks there is a natural site fit for one close at hand if it were only taken advantage of.

Joseph Hoare, fisherman, 36 years resident at Rush, remembers the harbour in a much better state. Rush used to be celebrated for its fish; the fishing banks lie 20 miles off shore; cod, ling, hake, and haddock abound, and yet, for want of a small safe harbour, this abundance is thrown away, and the fishermen of the place are in beggary. Has sounded over the site of the proposed harbour, and found 12 feet water at the end of the rocky ledge; thinks that two piers might be built for little money.

Josh. Welsh—Has been 30 years at sea; is master of a vessel trading to Whitehaven, and discharges cargo here only once a-year; could formerly discharge with ease; is of opinion that the sand in the harbour has increased, owing to the encroachment of the sea on the neighbouring shores; all agree in the want of a harbour, and if they had it, the herring-fleet would probably resort hither, as the situation is so central between Howth and Clogher Head; thinks well of the proposed site.

Lieut. Senior, R.N.—Has had 10 years' experience of fishermen on this coast, and fully agrees in all that has been said of the hardship imposed upon the Rush fishermen from the want of a small secure harbour. The number of fishing-boats is 18, of yawls 27, which employ 300 men and boys; in short, half the population of the place is dependent upon the fishery, and they are now in great poverty; thinks favourably of the proposed site for piers, and heartily hopes some steps to accomplish it be taken at once.

Irish Sea.

No. 143.
Beechey, on the Artificial Harbours of the Irish Sea.

No. 143.

Memorandum by Captain F. W. Beechey, R.N., F.R.S., *on the Artificial Harbours of the Irish Sea.*

Sir,

H.M.S. Firefly, Pembroke, March 5*th*, 1846.

With reference to the artificial harbours in the Irish sea, I send you the copy of a memorandum which I have had by me some time.

In the space occupied by my survey, that is, between Lough Foyle, Liverpool, and Waterford, there are nine artificial ports which were planned to be accessible at all times of tide. Of these, six have been

APPENDIX B.
IRISH SEA.
No. 143.
Beechey, on the Artificial Harbours of the Irish Sea.

erected at the expense of Government, and three by private companies or individuals; viz., Donaghadee, Port Patrick, Howth, Kingstown, Holyhead, and Dunmore, on the part of the Government; and Port Rush, Whitehaven, and Ardglass, on behalf of others.

Of these nine harbours it is grievous to think that the small harbour of Holyhead alone is the only one at the present day in which, during stormy weather with the wind on shore, vessels can lie in security in all parts of its waters; or rather it is the only port which has answered its intended purpose. Either they have filled up and become inaccessible; or their anchorage is so exposed from the erroneous position of the entrance, that they are unavailable and unsafe asylums: and besides, the sites of most of them have been badly selected.

Beginning with Donaghadee, the first of the Government ports in the north, we find it erected upon a nest of rocks; in the centre of the port, small as it is, there are large stones with only 5 feet water upon them, just 230 feet within the pier head; and outside the pier head, at one hundred yards, immediately off the entrance, at 240 yards, there is a rock with only 4 feet water on it; and in the same direction, nearly at 400 yards' distance, there is another with only 6 feet water on it. The entrance, although 150 feet in width, admits the swell so freely, that with the wind any way on shore from north or south, it is either inconvenient or positively unsafe to lie alongside the pier, according to the strength of the wind and sea in the offing: so that I have been obliged to quit this harbour in a small steamer on the approach of a gale. Owing to the position of the entrance in this small port, there is neither smooth water nor room for a vessel to round in, in bad weather, without endangering those lying at the pier.

Nearly opposite Donaghadee is Port Patrick—a nook with only 3 feet water right across the harbour at about a vessel's length within the horn of the pier. It is constructed on a bold rocky coast with deep water close outside the pier heads, and is exposed to such a heavy sea in stormy weather, that the sea running up the tower of the lighthouse, and rolling over the pier, is the common sight of the country to strangers who visit it in such weather, and nothing but the consummate skill and nerve of the pilots of the place could so long have enabled the packets to use this port with so few casualties. The berth for the packets, two in number, has been partly dug out of the shore; the vessels, when there is water sufficient, are turned into this dock by a rope cast from the bow to a rock; and, when in, they just fit the ditch. When there is not a sufficient depth of water, they run a-ground, and bump upon the sand (for which they are provided with suitable bilge pieces) until there is, and then they are twisted round the rock to their berths.

A vast deal of money has been expended upon this port: the northern pier has been frequently washed down, nearly as fast as it has been pushed out, and the southern one not long ago was nearly washed away, lighthouse and all. In short, it has hitherto presented a series of struggles between the skill of the engineer and the violence of the ocean; and we might almost say in which, if the former prevail, he will succeed in constructing a very inefficient harbour.

Next in order is Howth, a small harbour built at the mouth of an estuary, which had long been throwing out its sandbanks, with the entrance of the port inclined towards the ebb, and of necessity soliciting the sand and silt with which it is charged to seek its asylum, so that its having filled up, and been abandoned, need not excite our surprise. Outside this port, at 100 yards off its entrance, there is a rock with only 9 feet water over it.

Kingstown harbour, in point of size, is one of the most splendid artificial ports in the United Kingdom, but owing to the width and the erroneous position of its entrance, its anchorage is so exposed that in easterly gales vessels cannot hold on, and many which have sought an asylum within the piers have been driven on shore and some wrecked. Various schemes for protecting the entrance have been devised, but none of them have as yet been adopted. It unfortunately happens, that the only side of the port which is safe in easterly gales cannot be appropriated to those vessels most requiring shelter, so that altogether this harbour has disappointed expectation.

Holyhead is a safe little harbour, in which vessels drawing from nine to ten feet water may always lie afloat at the outer half of the pier, and the harbour is so protected that those vessels which ground upon the mud are in no danger in any weather. In heavy westerly gales alone is there any difficulty in getting into this port, and that might have been obviated in the commencement; at which time also, had this port been wisely considered, a much greater area might have been enclosed without a much larger expenditure.

Lastly, we come to Dunmore, a small port built for the accommodation of the Waterford packets. This port, like Howth, has greatly silted up and been abandoned by all but the fishing smacks, to whom it is still very useful

Such is the account of the ports which have been erected by Government. Of those belonging to individuals, Port Rush in the north is so badly placed and ill constructed that in westerly gales there is less danger at sea than alongside its pier. The run of the sea is so great that scarcely any ropes will hold a vessel, and if she parts she is, in an instant, on the rocks. The harbour has also silted up, with the exception of a small canal alongside the pier.

Whitehaven presents a succession of artificial harbours, one within the other. The outer one, which is the last built, is a splendid fabric, and encloses a large space, of which the only regret is that it cannot be made use of in bad weather, except as a passage to the inner ports; and that only after half tide. The outer part of this harbour, when first built, had sufficient water for steamers to gain the pier at all times of tide, but now there is only a small ditch, which has apparently been kept open by the action of the paddles of the steamers which occasionally touch there. In this deep a small steamer might still lie afloat if it were safe to do so, but the swell rolls in so heavily with strong winds on shore that it would not be safe to be caught there. The rest of the port has so silted up that it is for the most part dry at low water, and there is only three feet across the entrance from pier to pier. It might not have been possible to prevent the silting up of this port without the use of dredges, but its area might have been better protected.

Lastly, Ardglass is another instance of a great mistake in point of site for a large outlay. Here was a very limited area shut in by a short pier jutting out on a bold rocky coast, so exposed that the first easterly gale which beat with violence upon its shores washed away the new pier, lighthouse and all, before even the light was exhibited, and the remains now lie in deep water. It may be questioned whether the area of the port, in which only one steamer could lie afloat, enclosed by this pier, if it had stood, was sufficient to justify the outlay.

Such is, I believe, a faithful and unbiassed account of the artificial ports within the limits of my survey; and which have cost the country much money. It is true that they are some of the earliest artificial harbours that were constructed by us, and they were planned at a time when steam was little thought of; our surveys of the coast were also very imperfect, and it would be unjust to impute any blame to the engineers, who, as regards the masonry, have, I believe, eminently performed their work. But there is much reason for believing that, were these plans and sites to be now submitted to a body of practical and experienced men, scarcely would one of them be adopted.

I am, &c.,
F. W. BEECHEY, *Captain.*

To Captain Beaufort, R.N.

No. 144.
Beechey, on the advantage of colouring Light-houses with a broad red stripe.

No. 144.

Capt. BEECHEY, R N., *on the advantage of colouring Light-houses with a broad Red Stripe; also Remarks on the same by a Master in the Royal Navy.*

SIR, *Holyhead*, 1st *October*, 1841.

A few days ago we had an excellent opportunity of observing the improvement that has been made in the colouring of the Maiden Light-houses, by painting a broad red stripe across the tower, which before was entirely white.

We were endeavouring to make these light-houses in very hazy weather, and when within about a mile, we observed three dark spots somewhat elevated, and a long dark line at the horizon. The spots proved to be the red band which had been recently painted, and the slated roofs of the light-keepers' cottages; whilst the dark line at the horizon was the natural colour of the rock below the whitewash, but no part of the whited tower or of the rocky island which had been whitewashed could be discovered; and it was not until we were quite close that we could discover a faint outline of these objects, the appearance of which may be imagined from the sketch annexed.

There could not have been a stronger proof of the great mistake that has been made in white-washing many of the light-houses in this sea, in the hope of rendering them more conspicuous, but especially in the Maiden towers and rocks, which have been annually coated with lime down to the water's edge, and had it not been for the red stripe and the dark roofs of the cottages, which could not be seen when viewed end-ways, the vessel might have been too close to have avoided the danger, and had this occurred, the loss of the vessel would have been entirely owing to the expensive process of whitening the rocks and towers.

On a clear day, when the sun shines bright upon a whitened tower, we must all acknowledge the brilliant effect produced by the lime, but at such times we care very little about light-houses, and at night the light is of course the best guide. It is, in foggy and hazy weather and during gales, which, in this sea are almost always attended with mists, that we want our land-marks, and there certainly is not any colour which at such times so effectually evades the eye as white.

Captain White, in his "Channel Directions," complains of the difficulty of discerning the Hook Light-house, in consequence of its whiteness; Lieut. Frazer, in his recent survey to the southward of Dublin, could scarcely make any use of the lower Wicklow Light-house, from the same cause.

I have frequently run for Carlingford Lough, at the entrance of which there is a beautiful light-house, 110 feet high, of snow-white purity, and in the misty weather which usually attends such exploits, have always seen the Black House, a low ruin about a cable's length inside the light tower, and even the black base of the tower below the whitewash, long before the tower itself could be distinguished.

I could furnish many other instances of a similar kind, but I hope that those which have been given will be sufficient to call further attention to the subject, and that the plan now upon trial at the Maidens, under the direction of that most excellent Board, the Ballast-office at Dublin, will be generally adopted. But I must observe, that at present the plan is only half carried out at the Maidens, as the tower has only one band of red, whereas it should have two, each one-third the height of the tower in width, and then the lantern may be white.

I must also remark, that this rule should not be applied indiscriminately to all light-houses; for instance, Port Patrick, the Baily, Mull of Kintire, Douglas, and, in fact, all light-houses situated close under cliffs, are decidedly more conspicuous when white; but all towers which stand alone, or which have half a mile and more of atmosphere between them and the back ground, should be striped, and the stronger the contrast the better.

I am, &c.,
F. W. BEECHEY.

To Captain Beaufort, R.N., Hydrographer.

SIR,

Being off the Maidens Rocks on the 23rd September, 1841, in hazy weather, the great utility of the red band lately painted round the light-houses was very apparent; this, the railing round the lantern, and the darkness of the two cottages at the base of the tower, being the only parts visible; it is evident that the roofs of these cottages in certain positions cannot be seen, we should, therefore, have been very close to the rocks before they were discovered, had it not been for the band.

As these dangers are five miles distant from the nearest land, swept by a rapid tide, and the lead gives us no warning of an approach to them, every means should be used to render them visible in hazy weather. This appears partly accomplished; and were there another band, leaving the centre of the tower white, it would be still more so, and at the same time prevent the possibility of their being (from a casual glance) mistaken for vessels under sail, which might be the case were they painted entirely red.

I am at a loss to account for the rocks being whitewashed, as they would surely be more easily seen were they left their natural colour, or blackened over. As it is in your power, through your valuable periodical, to call general attention to so important a subject, I venture to trouble you with this note.

I am, &c.,
A MASTER, R.N.

To the Editor of the "Nautical Magazine."

SKERRIES.

No. 145.
Memorial of Owners and Masters of Vessels at Skerries relative to throwing Ballast into the Harbour.

No. 145.

Memorial of Owners and Masters of Vessels at Skerries, relative to throwing Ballast into the Harbour.

SIR, *Dublin, 2nd May*, 1846.

I have the honour to submit the enclosed, and suggest that the application be laid before the Lords Commissioners of the Admiralty, and that full authority be given to the Coast Guard to prevent so injurious a practice.

I am, &c.,
JAMES DOMBRAIN, *Inspector-General.*

To Captain Phipps Hornby, R.N., C.B.,
Comptroller-General of Coast Guard.

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SKERRIES.

No. 145.
Memorial of Owners and Masters of Vessels at Skerries relative to throwing Ballast into the Harbour.

SIR,

Malahide, 1st *May*, 1846.

I have the honour to forward a memorial from the masters of vessels and fishermen at Skerries, and to state that I consider their assertions to be true. I also beg to refer you to the Skerries Boarding Lists, as during the last month 94 vessels threw out their ballast in various parts of that harbour, each vessel carrying 8 tons.

I am, &c.,
J. W. GILBERT, *Inspecting-Commander*.

To Sir James Dombrain, Inspector-General
of Coast Guard in Ireland.

TO THE LORDS COMMISSIONERS OF THE ADMIRALTY.

The humble Memorial of the Owners and Masters of Vessels belonging to the Harbour of Skerries, in the Port of Dublin.

Your memorialists beg to lay before your Lordships the following statement, with regard to the said harbour. Since the 10th of February last, there have been 180 Wicklow vessels that have thrown their ballast overboard, either in the harbour or roadstead, and on an average 8 tons per vessel. Skerries is the only safe harbour in this neighbourhood that in a heavy gale of wind a vessel can run for to save life and property, and if an immediate stop be not put to the throwing out of ballast, it will be filled up.

(Signed) CHARLES BOYLE, P. P.
JAMES GOWDER.
CHRISTOPHER QUINN, and 16 others.

No. 146.

ISLE OF MAN—PORT OF DOUGLAS.

ISLE OF MAN.

No. 146.
Evidence taken at Douglas on the 5th Nov., 1845.

Examining Commissioner—Captain WASHINGTON, R.N., F.R.S.

Present:—THE HIGH BAILIFF; Captain Sir ROBT. HAGAN, R.N.; Mr. MOORE, (Hills): Mr. M'GUFFOG, Collector of Customs, Mr. R. QUIRK, Deputy Receiver-General; Captain SKINNER; MR. ROGERS; Mr. TORRANCE; Mr. R. FARGHER; Mr. CLUCAS; Mr. TIMPERLEY; Mr. GARRITT, and Mr. WALSHE, &c.

Mr. RICHARD QUIRK (Deputy Receiver-General) examined.—Was acquainted with the Engineer's reports and statements of account furnished to the Secretary of State in answer to a requisition of Government, and could speak to their accuracy. All had been returned except the one of 1814, which he now had in hand. Alterations had been made in the Harbour according to Sir John Rennie's Report. No written complaints of the state of the Harbours had been made; but there had been various verbal complaints, chiefly on account of the deficiency of water. The Harbours were governed by Acts of Parliament, 11 and 54 Geo. III., only partially repealed by the 7 and 8 Victoria—the authority to make bye-laws remaining the same. Under the former Act the Commissioners were elected. There were eleven Harbour Commissioners, they all required a qualification except the chief officers of the Customs, who were *ex officio*. The whole funds were from time to time expended in maintaining and repairing the harbours as authorised by said Acts. None of the gentlemen now in office were either sailors or shipowners. Was not sure what the definition of a merchant was under the Act; doubted whether shipowners were such. Would furnish a list of their names and occupations from the books of the Commissioners; the major part of them formed a quorum. If the major part were not present the others had no authority to do any valid act. Vacancies were filled up by election by themselves, according to the Act. There was a merchant Commissioner for each town. They were undoubtedly elected by themselves: the Act gave rate-payers no vote. Part of the minutes of the meeting of 10th October, 1844, were not signed; that might be because gentlemen went away before the conclusion of the meeting; memoranda of the proceedings were always made; memorials from Ramsey had been presented, but no decision had been come to. There appeared to have been no meeting of the Commissioners from the 24th of February to the 10th of October. The works agreed upon were going on during that time. The Act required but annual meetings, as construed by the Commissioners.

Mr. MOORE (Hills) said that there ought to be monthly or at least quarterly meetings. He complained that he, as a Commissioner, knew nothing of what was going on; he was not consulted at all till the money was wanted for the expenses. He wished for some explanation?

DEPUTY RECEIVER-GENERAL.—The Harbour Funds were paid into the Receiver-General's hands quarterly. There was then to be an audit of the accounts, and by a fair construction of the Act quarterly meetings were required. There were no special reason why the meetings of the Commissioners were not held more frequently. The Commissioners audited their own accounts. These accounts had not been published for some time: they were always audited by the Commissioners.

Mr. TORRANCE.—That was far from satisfactory to the rate-payers.

No account had been published since 1837; the accounts had the signature of the Receiver-General and the Commissioners. The auditors did not all sign the account; they sometimes signed a minute, certifying that the accounts were correct. Returns of the gross receipts of the Customs were made out in 1844, in obedience to an order of the House of Commons; there had been no voluntary publication. Some doubt had existed whether the Act authorised the publication. The Receiver-General had written to ascertain this in 1834; no answer had been received till 1836, and the accounts had been published voluntarily in 1837. The rate-payers might always see the accounts, but they were not published. The accounts were strictly accurate. The meeting of the Commissioners was held in a room, and not public. Had been in office since 1833, altogether about thirteen years.

Mr. ROGERS here handed in a letter from Sir William Hillary, with copies of the baronet's publications relative to the proposed Central Harbour of Refuge. Sir William deeply regretted his inability, from his weak state of health and severe domestic afflictions, to be present.

Fort Anne, Isle of Man, 5th *November*, 1845.

SIR,—It has afforded me great satisfaction to learn your arrival in the Isle of Man, for the important object of inspecting the ports and harbours of its dangerous shores, and having devoted the best years of a long life to the maritime interests of my country, and the preservation of my fellow-creatures from shipwreck, I should have felt it a gratification and a duty to have availed myself of the public notice this day given to attend you at the Court-house. But, owing to a long illness and severe domestic afflictions, I have for several months been confined to my house, and am entirely unable to go the shortest distance—which on this occasion I greatly regret, as there are many important points connected with your inquiries on which I would much wish to have the honour of conferring with you; but to put you in possession of my plans, and amongst many others the strong conviction I have long felt of the *great national importance* of constituting on the coast of the Isle of Man a central Harbour of Refuge for the Irish sea, which you will

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find amply detailed in the pamphlets and papers which I shall take the liberty to transmit to you herewith. By these you will learn the plans and projects long earnestly sought for by the inhabitants of this Island, with the maps of the projected harbours, and the proceedings of the various public meetings at which I was called upon to preside. I believe I was the first to suggest a great central harbour of refuge for these seas, and I thought Douglas might be the most eligible situation for such a national work; but which if constructed on a scale worthy of the British nation, might embrace a larger space than we have hitherto pointed out, and by extending the breakwater *boldly across the bay* might erect a stupendous port for the navy of a great empire.

I shall request my friend, Mr. Rogers, who has acted for me as secretary at our committees and public meetings, to place these papers in your hands, and to say if you will do me the honour to come up to me at Fort Anne, at any day and hour you may find most convenient. I shall feel glad to see you and any gentleman who may accompany you; and, I may add, that I do not think there is any situation from which with the least trouble you could more completely inspect this bay and coast.

I have, &c.,

Capt. Washington, R. N., &c., &c. WILLIAM HILLARY, Bart.

The COMMISSIONER said he should feel the greatest pleasure in calling upon Sir William Hillary. He had for many years been aware of Sir William's exertions in so good a cause, and he had long since resolved, that if he ever had the good fortune to visit the Isle of Man, the worthy Baronet would be the first to whom he would pay a visit.

DEPUTY RECEIVER-GENERAL.—The 7th and 8th of Victoria had repealed the rating clauses. 2300*l.* was now paid from the Douglas Custom House for that purpose. The engineer always made out a report and estimate for what was wanted, and afterwards proceeded according to the order of the commissioners. About 5*l.* per week was expended on Douglas harbour. The mode of drawing money was on the certificate of the engineer, that such work was done, at such a price; and then the check of the resident commissioner was given for the amount. Works were carried on by contract.

Mr. TIMPERLEY, Resident Engineer, examined.—He was responsible for the works being properly done; he paid less than the amount by ten per cent. till finished, and if satisfied paid the balance. The contractor, and not the workmen, was paid by him. The contract for the new pier at Castletown was notified by public advertisement. The plans were sanctioned by the commissioners.

Mr. MOORE again objected, and said that Mr. Timperley came down and made his contracts unknown to him, without notice, and that he had never been consulted, and he had decidedly disapproved of works which had been done.

Mr. TIMPERLEY said he never proceeded without verbal orders from the board. The plans were approved of by the commissioners, and afterwards by the Lords of the Treasury.

Mr. MOORE wished to ask the Engineer if he had not been some time since directed to erect a kind of landing-place for the steamers at the Pollock Rocks?

The ENGINEER said the Deputy Receiver-General had instructed him to look at the place. He had done so, but did not think what was proposed would be effective, or that it would have been a justifiable outlay of the public money. He had returned a verbal report.

DEPUTY RECEIVER-GENERAL.—There had been money borrowed, as authorised by the Act, to carry on the improvements. They had received a Treasury order in 1840 for 10,000*l.*, but found 6000*l.* was sufficient. This was the only and entire debt of the commissioners. Interest was payable at the rate of 5 per cent. The Act did not give the power to borrow elsewhere at a less rate of interest and pay off this debt. There were now no harbour dues, and they were maintained by an annual grant of 2300*l.*

Mr. GARRETT, jun., said that was the balance after the expense of collecting; they ought to have received 2500*l.* The trade and consumption of the island had increased much since the new fiscal law.

Examination continued—The 6000*l.* had been expended for the harbours at Derby haven and Ramsey. The Douglas Head Light was maintained by the Harbour Commissioners. The gross amount now paid for salaries was,—Engineer, 200 guineas, besides travelling expenses; Receiver-General, 30*l.* for travelling expenses. Mr. Walker had been paid 319*l.* for plans of the Harbour. Sir J. Rennie had been paid two sums, of 270*l.* and 140*l.* The Harbour-masters of Peel, Castletown, and Ramsey, had 30*l.* each, and Douglas Light cost about 204*l.*

DEPUTY RECEIVER-GENERAL.—Sand had been taken away from the shore, and there were now bare rocks where the whole was once covered with sand. Damage had also been done to private property; complaints had been made to the Governor by private individuals, and as a watering place, the town had sustained injury, these sands having been a great convenience for bathing.—The harbour had been deepened within the last two years; in 1844, 10,718 cubic yards of gravel, &c., had been removed, at an expense of 407*l.* 3*s.* 3*d.*; in 1845, 785 yards, the expense 55*l.* 9*s.* 9*d.*

Mr. MOORE said he had disapproved of the manner in which the work had been done.

Mr. FARGHER.—The Engineer had said all the work had been let by contract, after notice through the public press: now he wished him to name one such instance?

Mr. TIMPERLEY meant public notice, but did not think it mentioned the press.

The COMMISSIONER had himself understood that notice had been said to have been given through the public press: it was so in his minutes. If any such instance had taken place it could be named. He thought there could be no better medium of publicity than through the medium of the press, which circulated over the Island.

Mr. TIMPERLEY had gone to those most likely to do the work well. If notice were given in the papers, all sorts of persons would apply.

Mr. FARGHER had put the question merely to prevent the Commissioner going away with a wrong impression. The question referred to a simple matter of fact, and he wished it answered.

Mr. TIMPERLEY thought it the best way to go to those best qualified to do the work, for there were not many people capable of such undertakings.

Mr. GARRETT asked if only one person was capable in Castletown? It appeared to him the thing had been made a job. He wished it to be known if even the new pier at Ramsey had not been propped up.

The ENGINEER denied that the pier at Ramsey was insufficient.

Capt. H. GILL, Harbour Master.—Had been 30 years at sea, and 22 years master of a ship, and rather more than a year Harbour Master. Received his instructions as Harbour Master from the Commissioners of Harbours on his appointment to office. Had power to enforce bye laws. Abstracts of the bye laws were published in the Almanacks. They were not painted and put up on a board, nor was a copy given to the master of every vessel. Had heard no complaints of soil having been removed from improper places. The harbour extended to the bridge. The tide in the harbour did not flow rapidly. There was a mill dam a short distance up the river; thought the tide would rise higher if the dam was removed, strong freshets washed down and deposited gravel in the harbour. This was not sufficient to scour away the accumulations out of the harbour. Spring tides flowed about half knot an hour, and the fresh about one and a half

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knots. Could not say positively if the mill dam was removed that the gravel would be carried away. The space above the bridge, he thought, would make a fine harbour, if the bridge were removed. The highest rise of the tide at the pier head was 22 feet; in spring tides 18 or 19 feet,—the average rise might be 15 feet, the averages neap 11 feet. At low water the harbour was dry. The rise of tide depended greatly on the wind, strong easterly gales increasing the depth as much as 3 feet. The harbour was deepest at the pier head, and gradually became shallower as they went further up. The bottom was composed of gravel and clay, and had recently been deepened by flats. Was not certain whether the gravel would be scoured away, if the mill dam were removed. The harbour at the lower end was 216 feet across. Was very badly constructed, and injury was frequently sustained by vessels in consequence of the swell. Vessels from 30 to 60 and up to 200 tons were often wind-bound by easterly winds for weeks, and could not get out. There was a bank in the middle of the harbour, on which, at spring tides, there was 12 feet water. The upper part was useful for beaching vessels upon, and on which small vessels might bring up. The width across at the upper part of the harbour was 200 feet. Could not suggest any material improvement in the present harbour. They wanted more room. The present pier was finished, he understood, in 1801, but is built in a very bad situation. It ought to have been carried out on Pollock Rocks, where there was a natural foundation. This would have been a much better plan. The Jetty erected in 1838 was part of the plan of Sir J. Rennie, but was of little use. It was then intended to lengthen the pier, but the Lords of the Treasury objected to the expense, as a breakwater on a much more extensive scale had been talked of, and their lordships thought if that were resolved upon, lengthening the pier would be a useless expenditure of public money. Did not know that anything could be done as at present. The pier in some places was beginning to bulge out, and the excavations had been made to its foundation for the purpose of deepening the harbour. The King Orry steamer drew about 10 feet, and could enter the harbour an hour and a half before high water. The upper part of the harbour was in a very bad state. It was built of small stones, and these were frequently falling out. They were constantly repaired by the Engineer. It was supported by wooden sleepers up and down. Much inconvenience was often felt in the harbour for want of space. The last year some vessels had been run into, and some of them dismasted. With south-easterly winds there was always a great swell, and at these times vessels had much difficulty in holding. In very heavy easterly gales vessels could not lie below at all. It often occurred that the swell was so great that the steamers could not venture into the harbour. There was a light-house on Douglas Head. There was a small bar at the entrance of sand and gravel. There had been many vessels wrecked near the entrance. The St. George steamer broke from her moorings, and was lost in 1830, The City of Glasgow, some years later, was nearly lost, and a sloop ran ashore last year near the mouth of the harbour It was difficult to get a rope ashore from a vessel with in-shore winds. There was no beaching ground, and there was no similarity in this to the entrance to Whitehaven harbour.

Capt. CLUCAS mentioned that large portions of land which had belonged to the harbour had been enclosed. The lake contained an area of 12 acres belonging to the harbour, and had been enclosed by degrees. The herring boats had been accustomed to lay there; but some years since a wall had been built by the proprietor of the Nunnery estate.

Mr. TORRANCE said even the bridge was an encroachment. The old bridge which had been washed away about 60 years since was considerably higher up. He conceived the lake to be of right public property.

HARBOUR MASTER.—If the lake were thrown open as a part of the harbour it would afford great additional space and convenience. The water there would be quite smooth, but the swell below would remain. This would afford great relief to the confined space of the harbour.

It was stated that the river to the bridge was part of the Nunnery estate, and a gentleman said it was only the fishing that belonged thereto.

The COMMISSIONER thought, as the Harbour Commissioners were conservators of the public rights, they ought to have looked after the matter. The Act 46 Geo. III., c. 153, defined all lands below the highest point of the tide flowing to be the right of the crown. The Queen was the sovereign of the seas, and of course all encroachments were illegal. A right might as well be claimed to erect a dam at the bottom as the top of the harbour. He could admit no private right below the highest flowing of the tide.

Mr. TORRANCE stated that a large piece of the public property had been enclosed near the Court-house about 20 years since a body called the Setting Quest, which had considerable power, had been invited to a dinner—

The HIGH BAILIFF said, according to the law of the Island, the Duke of Athol, then Lord of the Manor, might grant a licence to enclose, if the Enquest reported as had been done, that such was not prejudical to the public rights. The ground alluded to had been so enclosed in 1813. [The licence it appeared had been granted to Mr. Scott, then Collector of Customs, Receiver-General, and Chief Commissioner of Harbours.]

Capt. CLUCAS.—The Duke had sold and conveyed the harbours to the Crown in 1765, and had not power to sell or licence in 1813.

The sea broke on a greater steep in consequence of the inclosure, and, no doubt, the swell was greater and vessels might thereby be lost and mischief done. The harbour was not safe, nor convenient, and in its present limited space he did not know how it could be improved. There had been occasionally damage done to the shipping in the harbour, and several vessels had been lost immediately under the Court House, and a steamer a very few feet longer than the Orry could not turn in the harbour.

Mr. MOORE, agent for the Steam Packet Company, mentioned, that in their new steamer, now building, they had ordered a rudder to be constructed at both ends, in order, as far as possible, to obviate the necessity of turning in the harbour.

Capt. W. GILL said their steamers had frequently suffered from the swell in the harbour. The bottom was hard gravel upon clay. The harbour had originally been made far too small. Vessels in stormy weather had gone out to sea, and had never been heard of.

Sir R. HAGAN suggested the removal of the Jetty as the first improvement. It appeared to him to have been placed there with extremely little judgment, and could be of no use.

The COMMISSIONER wished it to be clearly understood that Government did not promise one shilling for improvements. His object was to obtain information, and be hoped there would be no misunderstanding.

Capt. W. GILL gave an opinion that the anchorage in Douglas Bay was not so good as in Ramsey Bay. Douglas Bay was chiefly gravel, there being only one spot of about 20 yards clay. The holding ground with an inshore wind was good in consequence of the drag being up hill. Vessels had been known to drag their anchors; for instance, the Vigilant, in 1822, the St. George broke from her moorings and waslost in 1830, and a large American vessel in 1811, when the whole crew was lost. And numbers had from time to time been wrecked in the bay.

The COMMISSIONER remarked that the St. George breaking from her moorings was a proof of good holding ground.

Mr. TIMPERLEY examined.—Had been resident engineer about four years, and was for about 14 years resident surveyor of the Humber Docks, and his last employment previous to coming here had been engineer of the Hull and Selby Railway, under Sir John Rennie. Douglas Harbour had been deepened on an

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average about two feet, and at the upper end six feet. The gravel had been carried out in flats, or used as ballast: none of it had been washed back again. The funds had beed expended in the general improvement: the excavation had been done for 4s. per ton. His salary and travelling was 250*l.*, the lighting was 250*l.* a year, including Douglas-head; interest on borrowed money was 300*l.*; and 300*l.* principal was paid off yearly. Douglas Harbour Master had 73*l.* in lieu of mast money; and each of the towns Ramsey, Castletown, &c., had 30*l.* each. After all which something under 900*l.* was available for improvements. During the last seven years the principal improvements had been at Derby haven and Ramsey, where the 6.000*l.* was expended; a pier or breakwater of 268 yards had been erected at Castletown, at an expense of 2,700*l.*, which had been of much service; 1,054*l.* in improvements in Peel. Douglas harbour had been deepened two feet. He did not think any means could be devised whereby the gravel could be washed away. After an inshore wind two or three feet had been accumulated on the bar during the past winter. Large stones were washed down of half hundred weight. The fresh might run five to six miles an hour. The river drained an extent of nine or ten miles of country, and was augmented by many small tributary streams.

COMMISSIONER.—When the Harbour Commissioners directed you to prepare plans and estimates, did they consult nautical men, none of them being sailors themselves?—No.

The COLLECTOR (Mr. M'Guffog) said when he was first in office, some years since, he was always glad to consult nautical men.

Capt. CLUCAS said they protested against the plans of the Commissioners. Nautical men were not consulted. There was not a place where a vessel could be repaired. They had memorialized the Commissioners to erect a slip on the Tongue, but no notice had been taken of the application:—no use to apply to self elect bodies. The harbour had been encroached upon by an erection called the Tongue, which was of no use but to let off for rent.

The ENGINEER thought the Tongue was very useful. The steamers lay there during winter, and it was useful for timber-vessels discharging.

Capt. CLUCAS said a graving dock was much wanted; he had a small vessel then repairing, and the carpenters could only work at her a few hours daily. Vessels were sent from the Island to repair. There were great complaints for want of a graving dock. No notice had been taken of their memorial:

THE ENGINEER thought a slip might be erected on the rock opposite the Court house, and a graving dock at the upper end of the harbour.

Mr MOORE (Steam Packet Company's Agent) said they required to paint the bottom of one of their steamers lately and were obliged to send her to Liverpool for that purpose, and were subjected to ten days' delay in getting into dock—when the thing might have been done here within two days.

The ENGINEER.—They had done what they could so far as the funds would go. He recommended a breakwater on a scale sufficient for the protection of the island trade, at a point some distance beyond the present jetty. 200 yards might be erected for 20,000*l.* 30 feet water at the end of low water. Was quite certain his estimate was right. Stones were at hand and could be brought to the spot on a short railway; and he had also calculated 500*l.* as the expense of a road past Fort Anne along the shore, which might be partly constructed of timber. It was important that steamers could land passengers at any time of the tide.

Mr. MOORE (Steam Packet Company's Agent), said the steamers had carried the mail upwards of 14 years, and on many occasions the packets dare not venture into the harbour, even at high water, the swell was so great. No later than November last year, the King Orry was compelled to take shelter at Port Erin, and could not land the mail for 24 hours.

The ENGINEER said Mr. Walker had recommended the erection of a breakwater. He thought 20,000*l.* sufficient in the meantime.

Mr. FARGHER said a breakwater would afford great protection to the fisheries. About 4,000 men and 400 boats, valued at about 80,000*l.*, were employed in the herring fishery. They often lost nights' fishings by reason of not getting out of harbour, which a breakwater would always enable them to do.

COMMISSIONER.—The welfare and accommodation of the fishermen is a most important consideration.

HARBOUR MASTER.—The number of vessels of all description, coasting and foreign, which had arrived at Douglas for the last 12 months was 1391; the tonnage 97,054. There were about 400 herring-boats from first September to eleveuth October, and employed from 3,000 to 4,000 men. The harbour at this time was inconveniently crowded, and the fishermen had often difficulty in getting out. There had been 16 wrecks recorded in Douglas Bay within a limited number of years, all of which, he believed, might have been prevented by the erection of a breakwater.

Sir R. HAGAN said the seas here were not so heavy as at Plymouth, Cork, and the western coasts of Ireland, and a breakwater in consequence could be erected at much less cost.

The ENGINEER said stones of any size might be obtained on the island, from half a ton to ten tons. They seldom, however, used larger than half a ton. They used grey slate stones at Ramsey, not larger than a foolscap account book, and being set up edgeways were found to be perfectly sufficient, and the pier was only partly built on dry land.

Sir R. HAGAN adverted to the malconstruction of the present works, and the positive injury the Jetty in particular was calculated to inflict.

Mr. MOORE said Sir J. Rennie's plan, when the Jetty was built, contemplated lengthening the present pier.

Capt. W. GILL thought that if that had been done there would have been less sea in the harbour.

The COMMISSIONER referred to an authenticated list of shipwrecks, prepared by Mr. Kelly, advocate, and wished to know if any one present could give evidence in support of its accuracy?

It was stated that Mr. Kelly was not present, but that there was no doubt of the accuracy of the list. Mr. K. was a notary public, and affidavits had been made, relative to the greater part of the wrecks, before him.

Capt. W. GILL had no doubt, many of these vessels might have been saved had there been a breakwater.

It was stated that vessels ran to the Isle of Man from Holyhead. The trade of Liverpool generally sailed to the westward of the Isle of Man, the Dublin and Whitehaven shipping, also Workington, Maryport, Annan, Dumfries, Kirkcudbright, and all the ports round to the Mull of Galloway passed close to the Island, as well as the steamers and other vessels from the Clyde to Liverpool. When the wind was south-easterly many vessels outward bound from Liverpool, if there was a refuge-harbour at the Isle of Man would run there. One-third of all the losses on the coast of the Isle of Man belonged to Liverpool. The Dublin, Whitehaven, &c., colliers passed from 2 to 5 miles from the island, and often from 20 to 100 vessels were to be seen at one time from the Manx coast. 30 or 40 colliers were often seen on their passage to Ireland. Also vessels from North America, and Baltic and Norway timber vessels to Liverpool. 40 or 60 vessels often ran for shelter to Ramsey bay. If a harbour of refuge was erected, Douglas bay was thought preferable, as having the greatest depth of water, and being the most central. Liverpool had taken some interest in this matter. The Corporation had sent their own surveyor, Capt. Denham, who had made

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plans, and had reported. A memorial from Liverpool had been transmitted to the Harbour Commissioners, and the High Bailiff of Douglas had attended a meeting in the town hall. The lighthouses had been erected in 1819 (except Douglas head, in 1832) and they had been of great use; but the list of wrecks were all subsequent to that date. Douglas head-light house was built and is now maintained by the Harbour Commissioners. Its light, Capt. Gill said, was visible for about 16 miles, and had prevented many wrecks.

Capt. Skinner called the attention of the Commissioner to Capt. Taylor's floating breakwater. Three sections had been laid down at Brighton, and although that was no fair trial, it had answered extremely well. He thought a fair trial might be given in Douglas bay. There was no duty on timber, and it might be erected at much less cost than in England.

Sir R. Hagan thought a stone breakwater was the only thing for Douglas, and he did not see the propriety of wasting what they were to get in an experiment.

Mr. W. Kelly begged to draw attention to the various encroachments which had, from time to time, been made upon the harbour. Within his own recollection, so far back as 1779, 1780, and 1782, the tide overflowed a great part not only of the Lake, now occupied as timber-yards, but even the site of Queen street, the quay at the upper end of the harbour, and the greater part of what was claimed as private property in that locality. He well remembered the boats, during the winter months, were hauled up on the Lake. Besides this, the space now occupied as the Bath Building Yards, the Baths, Braid's Yard, &c., near the Parade, were all open, and considered as belonging to the public. He thought the Harbour Commissioners, as conservators of the public rights ought not to have permitted these enclosures, the greater part of which had been made within the last 30 years.

Mr. Fargher begged to state briefly, a few particulars relative to the encroachments to which allusion had just been made. He had consulted the documents in the Record Office, and found that four years after the Duke of Athol had sold the Island harbours to the British Crown, viz., on the 29th June, 1769, he had granted a licence of the ground now occupied as the timber-yards to Peter J. Heywood, upon a lord's rent of 3*s.* Manx. This license was dated at Dunkeld, on the 3rd May, 1769. On the 23rd April, 1772, a license was granted to Mr. Bacon, at a lord's rent of 12*s.* for certain ground near the Parade. He was prepared to prove by the evidence of the oldest inhabitants of the town now living, that they remembered the Lake, and all round about the bridge, to be a common, used by the public, and that the tide overflowed the whole of it. The late Major Taubman had built a wall, piece by piece, and thus enclosed it; but a space of 30 yards was ordered to be left open for the boats to be drawn up, and for the watering of cattle. He denied the right to hold this as private property; the Duke of Athol having no power to license any part of the harbours or what the tide overflowed subsequent to the date of his disposing of the harbours in 1765. The ground had been rented only for about 12 or 15 years, and was now in the occupation of Messrs. W. and R. Quiggin, and J. Moore and Co., as timber-yards.

The High Bailiff said the property had been sold for 800*l.* to Major Taubman; but in explanation it appeared the sale referred to by his Worship was for an adjoining property enclosed by a person named Bridson, previous to 1765.

Mr. Fargher.—The area of the ground in question generally known as the Lake might be about 10 or 12 acres. There could be no doubt the tide overflowed it. The timber was frequently floating in the yard, and even the mill was sometimes stopped by the spring tides. He adverted to the value of this as a harbour—its security—and showed at how much less expense it might be made available, in comparison of building piers out to sea. He gave the names of the following persons, now living, who could speak to the accuracy of what he had stated: Messrs. R. Cannell, R. Cowley, H. Alexander, Thos. Watterson, T. Creer, J. Curphey, W. Clucas—the latter being the mason who had built the wall.

The Commissioner supposed there could be no doubt but the facts were as stated.

Mr. Fargher next alluded to the encroachments at the back of the Court House. Some small part of this ground, he believed, had been licensed to Mr. Bacon prior to 1765; but the encroachment chiefly complained of was made in favour of one who was and ought to have been the conservator of the crown rights. He referred to Mr. Scott, nephew to the Duke of Athol, who had obtained licences for such encroachments at various times from 1807 to 1809. This Mr. Scott, it should be remembered, was Receiver-General, Collector of Customs, and Chief Commissioner of Harbours, and, above all men, it was his duty to see that the rights of the public and the crown were protected.

Commissioner.—Undoubtedly. The chief Commissioner ought to have protected the public rights.

Mr. Fargher then proceeded to describe the locality. Since the wall had been built it formed a bulwark; the surge was very heavy, and with south-east winds was very dangerous. Several vessels had been lost, in some all hands had perished; and the situation was such that no assistance could be rendered from the shore.

Mr. Torrance mentioned the case of a Highland sloop which had been lost there some years ago.

Mr. Fargher continued.—There was another subject to which he would briefly direct attention. He alluded to the Act 2 Geo. III., under which the Harbour Commissioners were appointed. The Receiver-General was himself the chairman, and appointed a Deputy Receiver-General; and holding the office of Water Bailiff also, he appointed three deputies—one each for Castletown, Peel, and Ramsey. These five gentlemen, four of whom were nominated by one man, and the three principal officers of customs at Douglas, had the election of the merchant Commissioners for the four towns. Thus the Receiver-General, being also the Water Bailiff, could, with his deputies in such elections, always secure the return of his own nominees. He contended that the holding of such offices was incompatible with each other—contrary to law, and opposed to common sense. If there was a candidate proposed by the Receiver-General or his deputy, and another by the officers of customs, he would beg to ask which was the most likely to be returned?

Mr. R. Quirk adverted to the last election, when Mr. Crebbin had been proposed by the collector and elected, although Mr. Spittall had been put in nomination.

Mr. Walshe never remembered to have heard Mr. Spittall's name mentioned.

The High Bailiff could not allow what had been stated to go forth unanswered. Colonel Stewart had received 400*l.* a year as Receiver-General; and on his death, the Government thought the offices might be united; and the Water Bailiff had, on receiving the appointment, agreed to discharge the duties without salary. Colonel Steward had appointed deputies in the same way as at present.

Mr. Fargher.—They wished to speak of things as they are, not as they were, for they were bad enough. He did not wish to speak disrespectfully of the Receiver-General, for a more worthy man in private life did not exist than Mr. Quirk; but he maintained that so many offices centered in one man was utterly incompatible. The High Bailiff had omitted to explain that the Receiver-General also held the offices of Clerk of the Council and Secretary to the Governor. There was another absurdity in the fact of both offices being centered in one man. He alluded to infringements of the Harbour Laws. He came into the court in the same suit as prosecutor and judge.

The High Bailiff denied this. Suits against parties infringing the Harbour Laws were brought by the Harbour Master, and not by the Receiver-General, before the Water Bailiff.

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Mr. FARGHER.—Nominally so. But the chairman of the Harbour Commissioners was the real plaintiff. He might set up any one as his substitute; but he was the real party prosecuting at this bar, and judge upon the bench at the same time. If the offices were held by different persons, such an anomaly could not exist. He next adverted to the anomaly of the Commissioners auditing their own accounts; and said it would be no greater absurdity for a master to ask his journeymen or apprentice, to certify what he required, than for the Receiver-General to ask the officers of his own creation to certify his accounts, the three officers of customs excepted. He adverted to the irregularity of the manner in which the accounts had been audited: in fact, the balance sheet had not been signed at all.

Mr. QUIRK endeavoured to explain that the accounts were audited, and handed up a book to the Commissioner.

The COMMISSIONER said he did not see a name in the whole book.

Mr. QUIRK explained that the peculiar way in which the accounts were kept, rendered it necessary that they should sign a separate minute in another book.

Mr. J. TATE here complained that he had frequently been charged the rates on goods in the harbour office according to the full retail value.

Mr. FARGHER next adverted to the publication of accounts. It was nine years since any account had been published, except a statement last year by order of the House of Commons. That statement had been rejected by the House as not being in terms of the order. He wished to know if the amended return had been completed?

Mr. QUIRK explained that the return had been made out in gross: and subsequently in detail, as requested by the House of Commons. He had at great labour made out the amended returns, although he was informed by the Harbour Commissioners that he need not have been at that trouble.

Mr. WALSHE wished to know at what meeting he had been so advised? He remembered nothing of it.

Mr. QUIRK explained, it might have been at a meeting at Castletown. He was ready to transmit the account if called for.

Mr. FARGHER.—The return printed had been rejected as incomplete. He wished to know if the order of the House had yet been complied with?

Mr. QUIRK said it was nearly made out, after great trouble, but that in part amended return was still in his possession.

Mr. FARGHER said it appeared they were too poor to publish their accounts in the Isle of Man. He, however, thought it strange the order of the House of Commons should be set aside by the *ipse dixit* of any Commissioner. They were however determined that the paid public servants should do their duty; it was right for the people to see this, and if they would not do their duty, they would find means of making them do it.

Mr. KELLY wished to know to whom they were to apply in order to obtain the public rights and secure a restitution of the encroachment?

COMMISSIONER.—To the Admiralty, as at present the Tidal Harbours Commission has no authority to act.

Mr. KELLY said the inquiry should be followed up, the matter would not be permitted to rest.

WILLIAM CLUCAS was the mason who had built the wall enclosing the lake. He received his instructions from Major Taubman's steward, and delivered by the major's authority. This was in 1820. It was built with stone, and might be about six feet from the foundation. About 30 yards were left open for the boats to be hauled up, and for the cattle to water. At high tides the whole lake was covered with water. Some years afterwards this opening was closed up, he supposed by the proprietor's orders, and there were many complaints in consequence.

Captain CLUCAS said complaints were useless. To whom could the public look for redress of grievances? There was no man in this Island that cared for the rights of the public, the authorities being a self-elect junta.

Mr. W. KELLY said the state of things was such, that no man dared to oppose the powers that be. He was sure to be a marked man. The press was in a state of vassalage, and not free. They would then, as now, have soon imprisoned for libel whoever dared to tell the truth. The high-road commissioners ought to have been the conservators of the public right.

The COMMISSIONER thought from the specimens which he had seen, that the Island press must be pretty free now.

The COMMISSIONER wished to know whether any gentleman was present who could speak to the rights of the proprietor of the Nunnery estate? He always desired to hear both sides; and had he known the nature of the complaint which had been brought forward, he should have given notice. Mr. Harris, agent of the Nunnery estate was present, but he had not heard distinctly what had been alleged.

Captain CLUCAS mentioned that several vessels had been wrecked in consequence of the limited accommodation which the harbour afforded. Dr. Bowring had well said their interests were neither represented at home nor abroad.

Mr. W. KELLY said complaints had not been made, because they found it of no use to make complaints.

Mr. MOORE, (steam-packet office), presented a memorial from the directors of the Steam-Packet Company, as follows:—

"*To the Tidal Harbours' Commissioners.*

"The directors of the Isle of Man Steam-Packet Company beg most respectfully to submit for the consideration of the Tidal Harbours Commissioners, the following amongst the many cogent reasons that exist for affording accommodation to the trade and best interests of this island, by the erection of a breakwater from the inner Douglas head, called the 'little head,' so that their valuable steam-packets may arrive and anchor safely at any time of tide, and sail under any circumstances, with the mails and passengers, without risk to lives and property, which, at present, they are constrained most emphatically to impress upon Her Majesty's government is a *most fearful service*, and lamentably inconvenient.

"This company have had the honour of conveying the mails between Liverpool and this port nearly fifteen years, during which time they have frequently been prevented by easterly winds from landing the bags from six to ten hours after the steamer's arrival off the port; and in November last year, the King Orry was compelled, by a south-east gale, to run round the Calf of Man to seek shelter in Port Erin bay, rather than jeopardize lives and property by attempting this dangerous port. On this occasion the mails were delayed twenty-four hours longer from the Post Office than would have been the case had the entrance to this harbour been protected. It has been no uncommon occurrence for the steamer to leave the bay for Liverpool without a possibility of taking the mails on board.

"The inconvenience and risk to passengers has frequently been very serious, from often having to land and embark from the rocks and sands in small boats, in heavy seas, at times that it would be utterly impossible to communicate with the pier head. The directors are happy to say, that during the existence of the company for upwards of fifteen years, no serious casualty has taken place, which may be attributed, under providence, to the experience of their respective commanders, and their perfect knowledge of this coast.

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"The liberality of the government having freed our harbours from all imposts, immediate advantage to the coasting trade has ensued, which the directors, in common with all interested in the safety of lives and property, feel gratified for; which circumstance alone would loudly call for a greater and more commodious harbour—no less than ninety-seven thousand tons of shipping having entered this port within one year, after the passing of the recent act affording this gratuitous accommodation.

"In addition to the increase of the entries of shipping, this port is the resort or great rendezvous of all the boats employed in the herring fishery, amounting to about 400, as well as other vessels connected with the fisheries for about three months in the year; and at that season the harbour is generally crowded to excess, so that it is with difficulty and danger, both to the steam and other vessels, that one or the other can enter or depart; and by which damage frequently happens, and great delay inevitably follows.

"By the late tariff for regulating the trade of the Isle of Man, her Majesty's government most unquestionably held out inducements to her subjects to visit this island, in preference to spending their money amongst foreigners. The result of this year has proved the wisdom of this experiment—no less than 32,000 passengers having been conveyed between Liverpool and this port alone in four months—being double the number that was conveyed during the same time in 1843; and this, it is fondly to be hoped, will yearly increase; but this increase in the prosperity of the island, will mainly depend upon the accommodation afforded to visitors—and that facility and inducement can alone be maintained and produced by the super-excellence of the steamers to be kept up on the several stations adjacent to this port, more particularly to Liverpool.

"To keep pace with the times and to afford accommodation and despatch in the conveyance of the mails and passengers, the company are compelled to employ large and expensive steam packets, and their boats are often subjected to serious damage by the heavy sea running within this port during easterly winds, by which one of them had the framing of her engines broken, by striking against the almost flinty bottom of this harbour; they have suffered by the breakage of her paddle-wings, and other serious damage. They have had to get up steam, during tide time, to prevent the consequence of breaking from their moorings in the port—as at times the best moorings have proved insufficient to hold them. The value of the company's property at present thus exposed, is about 30,000*l*., in addition to which they are now building a first-rate large steamer at a cost of upwards of 22,000*l*. more.

"It is, therefore, manifest that such a profitable traffic to this island, as well as the enjoyment and recreation it affords the numerous visitors, is well worthy the kind attention of Her Majesty's Government in causing a suitable low-tide harbour to be formed in Douglas Bay, upon the most approved plan, and with as little loss of time as possible.

"The directors beg leave most respectfully to take the opportunity of pointing out to the Commissioners the necessity there exists in this port, and the serious inconvenience and heavy expense to which the company are subjected in having to send their steamers to Liverpool or elsewhere, for the repair of their bottoms, from the want of a graving dock, patent slip, or gridiron, all of which the harbours of this island are entirely deficient in. The advantage of either of these would now be greatly increased from the introduction of new iron steamers, which require frequent examinations and coating of their bottoms.

"We are, Sir, your obedient servants,

JAMES LEWIN. RICHARD QUIRK.
THOMAS BRIDSON. H. B. NOBLE."
JOHN WINRAM.

The COMMISSIONER said the memorial was a very clear, distinctly set forth, and an important statement. He should take care that it was laid before the Tidal Harbours Commission.

Mr. GARRETT, junr., wished to know if Mr Timperley had not stated on Wednesday, that the new pier at Ramsey was sufficient? If so, he wished to know why it was propped up with bulwarks, sleepers, iron-clamps, &c.? He (Mr. Garratt) had been distinctly informed by Mr. Paton, the agent for Lloyd's, that there had been large holes in the pier, and that it was, in point of fact, not sufficient, as had been stated by the engineer.

Mr. TIMPERLEY said the pier was sufficient. The wood and iron alluded to had been put up for its preservation, and to prevent vessels running into it.

Mr. GARRETT explained that if Mr. Paton had had due notice, he would have attended; but he did not know of the meeting until the bellman had gone round, after eleven, saying that there would a meeting at eleven. He wished to know if public notice had been given, and if the contract for Ramsey Harbour had been given to the person who had given in the lowest estimate?

Mr. TIMPERLEY explained that the contractor had been named by the Ramsey Commissioner as a respectable man, and as fully competent to do the work. He (Mr. Timperley) would undertake to write to the contractor, to know if the statement of the agent at Lloyd's, relative to its insufficiency, were correct.

SIR R. HAGAN supported the Memorial of the Steam Packet Company, which he thought contained many excellent suggestions. He had no other plans to propose. He wished, however, to know if the Report was correct, that the account of the Commissioners was overdrawn at Messrs. Holmes' to the extent of 1800*l*.?

Mr. QUIRK explained that the Commissioners had a current account at Messrs. Holmes. They had only taken up 6000*l*. of the 10,000*l*. authorised to be raised by way of loan. Mr. Holmes was very kind in making advances.

The COMMISSIONER distinctly understood Mr. Quirk to have stated on Wednesday, that the harbour funds were not in debt more than this 6000*l*., and he wished to know if a minute of this debt had been made at the last meeting of the Commissioners?

Mr. QUIRK further explained that the balance up to July was 1130*l*., and the subsequent increase had been for work paid for since that time.

The COMMISSIONER had distinctly understood that it was stated there was no debt. Indeed, on an inspection of the book, the fact of such a debt existing did not appear very conspicuous to him.

Mr. WALSHE said he did not know of the existence of such a debt.

Mr. FARGHER said the inhabitants of this island had a strong claim on the Government for a liberal grant towards the erection of piers and harbours. Since the year 1805, the amount of surplus revenues remitted to the Treasury, after paying the entire expenses of our local government, could be little short of half a million sterling; but our insular legislature, or House of Keys, being a self-elected and irresponsible body, the British Government would not entrust the expenditure of public monies into such hands. If, however, the House of Keys were elected by the people, and responsible for their acts, there could be no doubt as to the validity of our claims; or the Government of England could not in justice deny to the poor Isle of Man the same right which she had, by the Act of 1778, conceded to all her other colonies without exception—that of expending all their own surplus revenues upon internal improvements. Upon this ground, therefore, the island had a strong claim upon the Government for a large portion of the above sum, not only for the erection of piers and breakwaters, but for the internal improvement of the country, in the construction of roads, &c.

The necessity of a breakwater having been alluded to by several gentlemen,

The COMMISSIONER thought that they ought at once, when it could be done for the small sum of 100*l*. or

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so, to erect some convenient place of landing from the steamers at low-water. For that sum they ought not to lose the character of the island, and it would be highly desirable that they should have it completed by the time visitors began to arrive next season.

Mr. QUIRK promised that the necessary survey should be made.

No. 147.

PEEL HARBOUR.

Examining Commissioner—Captain WASHINGTON, R.N., F.R.S.

Present—JOHN MOORE, Esq., of the Hills, and THOMAS CURRAN, Esq., Local Commissioners of Harbours, Mr. PATRICK CURRAN, Collector of the Port, the COMPTROLLER, the Rev, Mr. HOLMES, Kirk Patrick, the Rev. Mr. QUALTROUGH, Mr. ROBERT KERRUISH, Harbour-master, Mr. HENRY HUTCHINSON, Hon. E.I.C. Naval Service, WM. KINGLEY, Esq., Advocate, M.H.K., Mr. CÆSAR CORRIS, Mr. HENRY GRAVES, Mr. HIGGINS, Mr. THOMPSON, Merchants, Mr. THOMAS CARRAN, Jun., Lieut. H. W. BURN, &c.

Mr. JOHN MOORE, as one of the representatives of Peel, stated that the fishery had out-grown the size of the harbour, that it consisted of 120 fishing-boats carrying 6 men each; of 20 smacks, coasting and carrying fish, of 6 men each, employing 840 men. That the boats and nets were worth 36,000*l.*, the smacks 10,000*l.*, and stock 2,000*l.*, making a total of 48,000*l.* embarked in fishing out of this port alone. The returns on fresh fish sold in England 9,000*l.*, on potatoes and salted fish 4,000*l.*, total 14 000*l.* annually, That, in fact, the harbour was altogether too confined for the trade of the place. This had been long felt and complained of as a grievance by the inhabitants generally, and which had been represented to the proper quarter, but without avail. Something indeed had been done for the place, but not in the direction wished for and most needed.

Mr. TIMPERLEY, the engineer, here stated that 1,041*l.* had been lately expended upon the port, 400*l.* and upwards in deepening the harbour some three feet, along the upper range next the quay, and in piling and planking the foundation. 600*l.* more had been expended in widening the said quay from the outer point to the Queen's yard.

The COMMISSIONER inquired if these sums had been beneficially expended, and it appeared to be the sense of the meeting that the greater breadth of the quay had facilitated the traffic, but that the deepening of the harbour, just mentioned, although it had done no harm, it could not be said to have done much good.

Mr. HOTCHISSON stated the portion excavated had filled up to the height of 16 inches.

Mr. ROBERT KERRUISH, harbour master, examined.—I have been out sea fishing a hundred times, and have made a voyage to the West Indies.

The ballast is not thrown into the harbour, but piled in heaps by the side of Peel Hill, and clear of the craft. It is composed of cobble stones, and used by the herring "fleet" and smacks as ballast for the season.

That part of the harbour which was lately deepened has filled up to the extent of some nine or twelve inches.

Some years ago it was feared that the river would undermine the upper portion of the quay, which was built partly upon *quicksands*, and in consequence it was thought advisable to divert the course to a straight line, parallel to the side of the Hill, by building what is called the White Wall.

COMMISSIONER—I fear that instead of permitting the stream to keep the harbour free of deposit, you have taken the trouble to prevent the good always resulting from such a current rightly directed.

The COLLECTOR stated that the quay, as then constructed, must have given way, for the foundation was laid over quicksand, and it was owing to this uncertainty that the White Wall was planned.

COMMISSIONER—What amount of capital is employed in the fisheries?

Mr. HENRY GRAVES presented a statement showing that 4,000*l.* was embarked in the traffic, and that the profits arising from herrings was 5,000*l.* per annum; and that 5,000*l.* more for the smacks (potatoes and fish) might be added thereto, making an aggregate of 14,000*l.* In fact we are a growing fishing community, and have not room for a craft.

Mr. CÆSAR CORRIS, examined—I have inclosed a portion of the upper part of the harbour. The portion walled in is 100 yards by 40. The object sought was to lay up our boats in safety for the winter, and to afford the like accommodation to others, upon payment of a small compensation.

Mr. WM. KINLEY, Advocate, explained that the right emanated from the Lord of the Manor, and that on actual rent being duly paid, and the limits enclosed, it descended, as any other land title, from father to son.

Mr. JOHN HALSE, master mariner, stated that the light was a poor light, and of very little use. They could make out the lights from the windows of the town before they could discern the harbour light. This statement was confirmed by several other masters of vessels.

Mr. JOHN MOORE wished to direct attention to the fact, that the port of Peel might be made of much greater consequence to the Island than a mere fishing station. While the south-east coast of Man has five ports, all well looked after, but one neglected harbour was to be found on the whole north-west coast—a large range of exposed shore, extending from the Point of Ayre to the Calf of Man. That many lamentable wrecks had been occasioned by the want of the Breakwater, and a more enlarged Harbour, and that a recent loss of life and property would have been averted had any such refuge existed. All of which requirements were distinctly pointed out in the memorial to the Lords of the Treasury sent in May last, of which the following is a copy:—

The humble Memorial of the undersigned Owners of Vessels belonging to the Port of Peel, the Inhabitants generally of the Town, and others interested in the Fisheries of the Isle of Man, to the Right Honourable the Lords Commissioners of Her Majesty's Treasury,

Sheweth,

That your Memorialists beg leave respectfully to call the attention of your Lordships to the confined state of the Harbour of Peel, which is found to be quite inadequate to afford sufficient accommodation for the increased and increasing number of vessels; not only those belonging to the Port and engaged in the Herring Fishery, but of the numerous other vessels similarly engaged, which make this Port their rendezvous during the Fishing Season.

That as an instance of the great lack of space in Peel Harbour, your Memorialists have only to refer to a recent circumstance, when a large fleet of fishing boats, in addition to those belonging to the Port, were through stress of weather obliged to take shelter at Peel during a severe gale; in which strait a great number of the said vessels had to be moored outside the mouth of the said Harbour, and along the ledge of the Castle rocks; had the wind on that occasion veered round to the northward, the destruction of a large proportion of those boats would have been inevitable, and the loss irreparable to many of the owners.

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That the place possesses ample facilities for improving the said Harbour by adding to and thus enlarging its present confined area, as is evident from inspection, and as shown from a Plan of the late Duke of Athol, drawn out by his command, and still in existence.

That as the Harbours of the Island are now free from Dues, it may with confidence be presumed that they will be more and more resorted to, since the short trial has given proof of the welcome results by the abolition of the said Imposts.

That the number of boats belonging to, and engaged in the Herring Fishery connected with this Port, and the amount of Capital invested in that Trade, far exceeds such investment in any other Port of the Island. That from the preamble of the Act of Parliament by which the Harbours of this Island are regulated and maintained, it would appear that the protection of the Fisheries is considered by the Government as of the first importance.

That from the returns of the expenditure of the Harbour Funds for the last ten years, which have been published by the House of Commons, it seems that the amount actually expended in the improvement of the Harbour of this Port, including the cost of widening the Quay and the partial deepening of the said Harbour, has been very trifling indeed in comparison with the amount laid out upon the other Ports of far less consequence, as far as the staple trade of the Island is concerned.

That no part of the Government Loan for the improvement of the Harbours of the Island of Man has been expended at Peel. That the Lighthouse on the Pier is so totally useless and inefficient as to be an object not only unworthy of the Port but discreditable to the Island generally. That your Memorialists have been compelled to trouble your Lordships, in consequence of their Memorial (the substance of the like import to that now submitted) having been presented in August last year to the Commissioners of Harbours appointed for this Island, and the same not receiving the slightest notice on their part.

Further: As a matter of the last importance, your Memorialists would state, that Peel is the only Port on the West Coast of the Island wherein Vessels can take refuge from the Point of Ayre to the Calf of Man, and on this plea would earnestly request your Lordships' attention to the facility with which this Port might be rendered a Harbour of Refuge, and the very small cost (in comparison with any other proposed for this Island) at which it could be constructed. A Pier might be formed from the Horse Rock in a sweep towards the East side of the Bay—a work perfectly feasible with economy kept in view, and which so carried out would give from four to five fathoms depth at low water spring tides. The shape of this Bay suggests the curve, as likewise the eligible entrance to the north-east. The proposed space is free and clear of sunken rocks or any other danger.

That the lamentable and total loss of the *Wilhelmina*, of Glasgow, with all hands, at Fleshwick, and the wreck of the *Dundee*, at Glentrunck, each place being nine miles distant on either hand from Peel: both disasters occurring on the same day (the 25th of January), were evils which probably might have been averted had any such Harbour of Refuge been formed here. In continuation: it is a notorious fact that several Vessels, during the present winter, as well as many others at previous periods, some of which it has been ascertained drew only ten feet water, have been obliged to keep the sea during heavy gales of wind. The above matters of fact demonstrate that this Port wants the remedy prayed for to allow a fair accommodation for the distressed mariner—the which capability might so easily be afforded; and your Memorialists beg that Commissioners may be appointed and sent down to examine and survey the Bay of Peel, and report upon the practicability of the views taken by your Memorialists.

Under these circumstances, therefore, they conceive and humbly submit to your Lordships, that the Memorialists have a paramount claim on the Funds placed at your disposal for rendering the Harbour of Peel sufficiently commodious for the Fishing Fleet and the increasing Trade of the place, and request your Lordships will grant such aid towards the general extension and improvement for the reasons assigned; and further, that your Lordships will take into your early consideration the propriety of converting the Bay of Peel into an Asylum Harbour for the Channel, both of which objects are consistent with the interests and rising importance of the said Port; and they will, as in duty bound, ever pray, &c.

Mr. BURN.—Their plan and survey by John Gawne, draughtsman, had been forwarded to the Treasury. They were, unfortunately, left with merely a rough draught—on which, however, they had pencilled the Breakwater since proposed, about 100 yards in length.

On the following morning the Commissioner, accompanied by the engineer, inspected the line of White Wall, the harbour from the top, Mr. Corris' enclosed portion, and the quay, when he repeated his opinion of the previous night—that the filling up was manifestly allowed by the diversion of the river's course, and suggested a floodgate to permit the current to sweep the quay side, and the river would then become an extensive benefit.

The Engineer appeared doubtful of the stability of the quay, whereupon the Commissioner recommended him to secure the same, and to try what it would bear.

Mr. MOORE pointed out where the original intacks extended, and corroborated the Collector's account of the insecure foundation; and stated that the quay was first built by private subscription.

On arriving at the outer part of the quay, the Commissioner asked Mr. Burn how it happened that in the printed copy of the Memorial to the Treasury he saw that a complaint had been made of inattention on the part of the Local Commissioners to their petition?

Mr. BURN replied that the Memorial to the Lords Commissioners embodied the common opinions and feelings of the inhabitants of Peel, as signified by their names to that document, and appealed to the two Local Commissioners as to the truthfulness of the present statement.

Mr. JOHN MOORE corroborated the statement. It was all uphill work with him and his brother Commissioner. Whatever was proposed for the benefit of Peel was always outvoted.

Mr. CURRAN confirmed this implication, and as instances in point refered to the lamp posts for the quay and to the Lighthouse.

The Deputy Receiver-General denied this; and contended that Peel, in all their deliberations, received its fair share of support and attention.

At Mrs. Munn's corner, which overlooks the proposed enlargement of the Harbour, the Commissioner inquired to what extent were the works pencilled in the drawing intended to be carried. The point was indicated and the length of the breakwater agreed to as 90 yards from the Horse Rock—the new quay to run out in that direction, so as to form a commodious harbour, taking in the wart, and commencing at Mrs. Munn's jetty.

The covering of sand in the bay was slight, and the anchorage good upon clay.

There are eleven feet water at the Horse point, and perhaps twenty at the proposed point.

Mr. BURN.—I can only form a rough guess of the cost. Our survey plans are in London, with the Treasury, and we have no data, but say 9,000*l.*

It was stated in reply to the Commissioner that the sand was regularly carted away from the shore for manure and other purposes, in defiance of the authorities of the town.

Appendix B.

Isle of Man.

No. 148.

Evidence taken at Ramsey on the 6th Nov., 1845.

No. 148.

PORT OF RAMSEY.

Examining Commissioner—Captain Washington, R.N., F.R.S.

Present:—The High Bailiff; Deputy Receiver-General; Mr. Creer; The Collector of the Customs; Mr. Callister; Mr. Timperley; Mr. Taggart, &c.

Deputy Receiver-General.—Ramsey is represented at the General Board by two Commissioners, the Collector of the Customs and Mr. Creer. The Collector seldom attended even the annual meeting. The suggestions made for the improvement of that port were attended to as far as their funds would permit.

Was not aware of any memorial to the Admiralty from the inhabitants of Ramsey.

The Commissioner stated that the following had been referred to him by the Admiralty with instructions to inquire into its allegations on the spot.

To the Right Honorable the Lords Commissioners of the Admiralty, &c. &c. &c.

The humble Petition of the undersigned Merchants, Shipowners, Traders, and Inhabitants of the town and district of Ramsey, in the Isle of Man,

Showeth,

That the bay of Ramsey in point of extent, good anchorage, and shelter, surpasses every other in this island, and is equalled by very few in St. George's Channel or the Irish sea, and it is therefore the accustomed resort of vessels bound on foreign voyages, and engaged in the coasting trade when overtaken at sea by violent storms, and affords greater security than can be obtained in any roadstead from Holyhead to the Clyde.

That the harbour of Ramsey is most eligibly situated on the margin of the bay, and by a moderate outlay judiciously expended, could be made capable of receiving vessels of considerable size, and would, if so improved, be of great convenience and safety to vessels which navigate the channel, and especially to the numerous vessels engaged in the coasting trade between Liverpool and Glasgow, and the various ports of Lancashire, Cumberland, the west coast of Scotland, the north-east coast of Ireland, and of this island, when unable from stress of weather to keep to sea, or even to ride at anchor.

That some years ago, a small jetty was erected at Ramsey, which has had the effect of deepening the harbour and increasing the depth of water there to the extent of four feet and upwards; and although it is apparent that by extending this jetty, and making slight alterations in the old quay, the harbour of Ramsey would afford so many advantages to the shipping interest of the port, and the numerous vessels engaged in the coasting trade in the channel, which has been pointed out by several of your petitioners to the Commissioners of Harbours for this isle, and urged upon their attention, the Harbour of Ramsey is allowed to remain in its present insufficient state, whilst large sums of money are being expended in attempts to improve other parts of this isle, which are so situated naturally as to render the expenditure little less than a waste of the public funds.

Wherefore your petitioners most respectfully beg leave to lay their case before your Lordships, and pray that your Lordships may be pleased to adopt such measures for the improvement of the Harbour of Ramsey, as to your Lordships on consideration of the situation and capabilities of the place may appear expedient and calculated to promote the maritime interests of the various ports in the channel, as well as of the port of Ramsey. And your petitioners will ever pray, &c. &c. &c.

S. Christian, Deemster, the High Bailiff.
T. A. Corbett, Vicar General.
Duncan Gibb.
Wm. Callister, Merchant.
And upwards of 150 others.

The Commissioner wished to know if any one present was acquainted with the above petition, and whether it had been submitted to the general local board. After some delay Mr. Callister acknowledged that his name was appended to it. Each clause was then inquired into *seriatim*; in reply to that which asserted that large sums of money were laid out uselessly elsewhere, whilst Ramsey was neglected.

Mr. Timperley said that so far from that being true, the contrary was the fact, as since the year 1838 the north pier had been extended 123 yards at a cost of 2,570*l.*; and the south pier had been widened, raised, repaired, and a new light-house built at a cost of 432*l.*; thus more than one-half of the whole money raised on loan from the Treasury had been expended on this single harbour. By these means a depth of 2 feet had been gained; the pier was built of slate stone, set dry; doubtless it would be an improvement to extend it to low water, but the distance was 350 yards, and the cost would be 15,000*l.*; the width of entrance is 150 feet; it would be a great improvement to cut off the awkward angle formed by the south quay; a beaching place was also wanted, and a spot for the heavy swell to expend itself in easterly gales. Quay accommodations also is much wanted, and it would be a great improvement to the harbour in every way to extend the quays to the westward. The tide flows 2 miles up above the bridge, and if the harbour were deepened, as it required, he thought the back water would keep it free.

Mr. Kneale said the ground where the western extension of the quays would come was his private property, for which he had paid what is termed Lord's rent, and produced a document, being something of the nature of a compromise between the Harbour Commissioners and himself respecting the land in question.

The Commissioner said by *Magna Charta*, and by the concurrent decision of all judges, the rights of the sovereign extended to wherever the tide flowed, and by 42 Geo. III. cap. 153, any one projecting a jetty or other building below high water mark of ordinary spring tides without giving notice to the Admiralty, was liable to a penalty of 200*l.* If by Charter, or otherwise, these Sovereign rights had been ceded to the Duke of Athol, or others, as far as the Isle of Man was concerned, the act of Revestment in 1765, and subsequent act of 1825, had undoubtedly restored these rights to the crown; he trusted, therefore, that the Harbour Commissioners would be very careful how they exceeded their powers, in entering into a compromise with respect to land, which from their very constitutions as a Harbour Board they were bound to protect from encroachment, and preserve free for the full action of the tidal waters.

Mr. W. Creer. All gratefully acknowledge the boon conferred by Her Majesty's Government on the island by taking off the Harbour dues, and the increase of traffic has been great in consequence. The exports were chiefly grain, cattle, horses, potatoes, and eggs to a large amount, upwards of 9,000 quarters of corn were exported in 1844 from Ramsey alone. As many as 673 vessels arrived during the last year; 20 vessels had been landing cargoes at once, and 15 waiting to do so, and which for want of quay accommodation they were unable to do. 55 vessels had taken shelter in Ramsey Bay at one time. The anchorage was good, bottom clay, and the bay was resorted to by many foreign and coasting vessels. A timber ship in 1834 rode out the winter here with only one anchor.

Mr. Taggart is the owner of a building yard on the north side of the harbour, and has now a ship in France; formerly much ship building had been carried on here, and he has built a vessel of 500 tons. He would be glad to draw a plan for the improvement of the port, he would not spare the land claimed by any private individual, but he trusts others would do as himself, and make some little sacrifice for the public good.

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ISLE OF MAN.

No. 148.

Evidence taken at Ramsey on the 6th Nov., 1845.

CHARLES BOAST has been 7 years Harbour Master, and 45 years at sea; does not allow ballast to be thrown overboard in the harbour; is of opinion that the harbour might easily be deepened by excavation, and it would be a great benefit to get even 3 feet more water, the soil might partly be disposed of for ballast, and it would be very convenient for vessels; the awkward corner of the south quay should be cut off at once: the light at the pier end is but a poor thing; the life boat sent in 1832 was too large and unwieldy; a small one sent in 1835 with a carriage, is no longer sea-worthy.

Ramsey Bay affords excellent holding ground; has seen 55 vessels taking shelter at once in a south west gale in August last.

No. 149.

CASTLETOWN.

No. 149.

Evidence taken at Castletown on the 7th Nov., 1845.

Examining Commissioner—Captain WASHINGTON, R.N., F.R.S.

Present:—The HIGH BAILIFF, Mr. GAWNE, the RECEIVER-GENERAL, Mr. T. MOORE, Mr. CROLLEY, Collector of Customs, Mr. J. QUAYLE, Mr. M. QUAYLE, Mr. DOWNES, Mr. DUFF, Mr. CUBBON, &c.

The HIGH BAILIFF examined:—Is a Harbour Commissioner. Castletown has become the resort of numerous fishing boats, both from Cornwall and from Ireland, partly owing to the fish having changed their locality; but Port St. Mary and Port Erin were in some winds better situated, as from the latter boats could put out at all times. Since the pier at Castletown was carried out the harbour was much improved. Something was wanting at Langness as a warning to vessels by night or in foggy weather, as it was a very dangerous point. Heard great complaints that the maintenance of the light at Douglas Head bears hard upon the local funds.

The RECEIVER-GENERAL.—Is Chairman of the Harbour Commission. All the clauses in the governing Acts of Parliament have been complied with. Is of opinion that one annual meeting of the Commissioners is sufficient. The Collector of Ramsey has not attended the meeting for several years; one of the Peel Commissioners also does not attend.

COMMISSIONER said a Memorial to the Admiralty from the inhabitants of Ramsey, stating that only a small portion of the sum borrowed had been expended on that harbour, while large outlays were made upon sites which nature had not intended for harbours.

RECEIVER-GENERAL stated, that this was the first time he had heard of this Petition; that so far from Ramsey not having had its fair share of the loan, it had more than one-half of the whole, namely, 3002*l.* expended upon its improvements.

COMMISSIONER.—The same had been proved in evidence at Ramsey; still there appeared to be some improvements, which, looking at the increasing trade of Ramsey, he thought should be carried out as soon as possible; 1st, The cutting off an awkward corner of the South quay. 2dly, The extension westward of the quays, so as to afford more quay accommodation. 3rdly, The prolongation of the North pier in a proper direction to low-water mark; the latter, of course, must be gradual, but funds for the two former, he was of opinion, might be found at once.

He had now to lay before the meeting a Memorial to the Treasury from the Port of Peel, dated 19th April, 1845, complaining that no notice had been taken of a similar Memorial submitted to the Isle of Man Commissioners in August, 1844. (See p. 250.)

RECEIVER-GENERAL.—There was a Memorial, but it was not discussed, nor does any notice of it appear in the Minutes; it is the general practice to listen to Petitions, but it seems not in this case; there were no funds available for the object sought; there is no fixed mode of appropriating money. The recent fiscal Act by which all dues on shipping had been done away with was a great boon to the island; formerly a vessel had been wrecked off the coast rather than seek shelter and render herself liable to port dues; the general traffic has much increased. The present plan of the pier at Castletown has not been submitted either to Mr. Walker or to the Treasury. Has no power to prevent sand being carried away from the beach.

Mr. TIMPERLEY produced a plan of the harbour, with the old and new piers, the former of which, it appears, was built upwards of one hundred years ago, partly by subscription of the inhabitants of the town and neighbourhood and the fishermen in general. It further appeared that both Sir John Rannie and Mr. Walker surveyed the spot, drew plans, and gave in estimates for the extension of the present old pier as far as low water mark, being an extent of from one to two hundred yards; that the cost of such work, together with excavating or deepening the channel from that point along the whole line to the top of the present harbour would be about 4000*l.*

The COMMISSIONER enquired how it came to pass that these plans were not acted upon?

After a good deal of circumlocution and delay, it transpired that a Committee of the inhabitants of the town had been appointed to confer with some of the harbour Commissioners, and Mr. Timperley; and these gentlemen, taking into consideration the limited extent of their available funds, considered it most advisable to lay out that amount in the present undertaking, rather than adopt the plan recommended by Sir John Rennie, and not strongly approved of by Mr. Walker.

Mr. TIMPERLEY.—The trade at Castletown had subscribed 500*l.*, of which 170*l.* was paid for the erection of the piers; it was built of limestone, quarried only 1½ miles to the southward, and hitherto had cost 2681*l.*; it could be extended 30 yards further at an expense of 1000*l.*, and another 1000*l.* would excavate the rocky basin contained between the old and the new piers; the building work was executed at 5*s.* per cubic yard. The present quays were in fair repair, and could be faced, if required, without difficulty. The contract for the new pier was not let by public tender, but circulars were sent to all likely to undertake the work. No sailors or fishermen had been consulted in planning it.

The COMMISSIONER considered it rather strange that Mr. Walker's sanction should not have been obtained to it. It appeared to be substantial work, nevertheless the depth of water was said to be only 1½ foot more than at the point of the present pier.

Mr. CUBBON condemned the late erection in toto; that it was, in fact, a perfect job, and at best only afforded shelter to a dry and useless harbour; that the plan of Sir John Rennie was that upon which he agreed to contribute his subscription, and it was based on common sense; that the old pier ought to have been extended into deeper water, and the channel of the harbour deepened from thence to the top of the harbour. In its present form it afforded shelter only to small vessels, and they were frequently neaped above the bridge. In fact, no vessel of even moderate draught of water could enter the harbour, notwithstanding the additional outlay of 2300*l.*; and that for his own part he should not contribute one additional farthing towards the subscription for improving the harbour.

The COMMISSIONER read a memorial from the inhabitants of Castletown to the Lords of the Treasury, praying to be relieved from the balance of a subscription entered into for the improvement of their harbour in the year 1840-41; and enquired upon what ground they sought the exemption?

Mr. KELLY stated that the grounds upon which they sought exemption were—that the Lords of the Treasury had granted permission to raise a certain sum of money for the erection of a pier at Castletown, which sum was more than sufficient to defray the expense of erection; and that under the circumstances

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Evidence taken at Castletown on the 7th Nov., 1845.

they hoped to be relieved. They further showed that the erection was beneficial to the vessels of the whole kingdom, and was much resorted to by English and Irish fishing boats, and it was unreasonable to call upon them to contribute for such purposes out of their private resources.

Mr. Quayle stated that the sum of 500*l.* had been subscribed by the inhabitants of Castletown and neighbourhood, and that one third of that sum had been actually paid by the parties whose names were appended to the list.

The Receiver General expressed his opinion as favourable to the prayer of the memorialists, and thought it only fair that they should be relieved from the balance.

Mr. Downes stated that the new pier was precisely in accordance with a plan which he had proposed upwards of thirty years ago, and that the work just erected afforded great shelter to the harbour as well as the basin lying between the two piers, insomuch that a steam packet might now lie in perfect safety at the point of the old pier. Mr. Downes further suggested that a good light house placed on Langness Point, would be the certain means of preventing many wrecks that occurred there; and thought that the present tower or landmark might easily be altered for such a useful purpose.

The Pilots and Fishermen who were examined considered such a light much wanted. Twenty-three wrecks had taken place on Langness and vicinity since 1822. These parties stated that the new pier was very wet, and that heavy seas frequently broke over it. That it did not yet sufficiently overlap the old pier head, and that the plan proposed by Sir John Rennie, that of lengthening the pier and deepening the water, would have made a better job. They further stated that the number of English and Irish boats had greatly increased of late years; that above one hundred frequently came into port on Saturdays; but in consequence of the neap tides every other week, many of those boats were compelled to go to Port le Mary or Derbyhaven. This was a loss to the town and an inconvenience to the crews.

The Harbour Master confirmed this statement, and said he had frequently known boats to be neaped above the draw-bridge—sometimes lose a fishing, and at other times have to discharge their ballast in order to get to sea. He was allowed 4*l.* a year for attending to the pier light. It was seal oil which was used in the light, and it was frequently very thick and glutinous. The quays, in general, were in good repair, excepting the old pier, which required to be faced.

The Commissioner could not recommend a light on Langness Point, as with the Calf of Man and Castletown lights, it might cause confusion, but as it appears that a 5-knot tide runs past the point, and that several vessels get ashore in foggy weather, he suggested that a beacon with a bell upon it would be the best warning that could be placed there, and as it could be done at a very slight expense he trusted that the local commissioners would sanction it at once. He must also remark that the pier lights both here and at Peel, and he must add at Ramsey, did not appear to him to be such as fishermen and coasters were entitled to, and he hoped steps would be immediately taken to remedy them.

Mr. Duff and Mr. Downes inquired as to the mode of electing the Merchant Commissioners for the several Harbours. They had no personal objections, but they thought these gentlemen should be elected oftener and changed. Some were not qualified under the Act. Mr. Moore had been a Commissioner for Peel for forty years, and has principally resided in Douglas, and was not a merchant as required by the Act.

Mr. Quirk stated, that so long as he had known Mr. Moore, he had always thought him an active Commissioner, and fought the public battles fairly, and therefore there could be no ground of complaint. The Commissioners were elected every three years.

The Commissioner inquired whether there had been any complaints of encroachments upon the rights of the Crown, and if so, whether the Commissioners had taken care to maintain and protect such rights?

The Receiver-General stated that he had heard of none, except one at Peel and another at Ramsey. In the former case they tried the question at law, where it was decided against them; and in order to avoid another law-suit, they had made a kind of compromise in the latter case.

The Commissioner expressed a hope, that in any cases which might arise, they would not act in such a manner; but try the question before the highest appeal Court; and that in any arrangements which the Commissioners might hereafter come to, with parties whose properties adjoined the lands over which the sea-water flowed, they would, by all means, avoid compromising the rights of the Crown; and in all such cases write across the plans of such grounds, that it was by agreement such lands were conceded and not relinquished by matter of right.

Mr. Quayle was not aware of the extent of the powers of the Crown in these matters, and always thought if lord's rent were paid for such lands, the title was good.

The expense of maintaining Douglas Head Light was spoken of at some length. The Commissioner expressed a hope that, as the Douglas Head Light might in a great measure be considered a coast light, a proper representation to the Commissioners of Northern Lights might induce them to defray the expense of maintenance, and thus leave a small sum more applicable to the improvement of their harbours, as they evidently stood in need of every shilling for that purpose.

Mr. Quirk stated that three or four years ago the Commissioners had considered the subject, and upon investigation they thought it more advisable for the present to make it a charge upon their own funds, rather than trouble the Commissioners of Northern Lights, fearing if they took it under their management that they would impose a rate on Manx vessels for its support.

The Commissioner expressed his surprise that during the passing of the late fiscal bill through the House of Commons, there was no friend of the island found who could have drawn the attention of Government to these things, and the necessity of paying such expenses out of a separate fund, or allowing additional compensation for them.

Mr. Quirk stated that the measure was hurried very rapidly through Parliament, and therefore the oversight.

Mr. Crolley, Collector of Customs, stated that several vessels had been wrecked on Langness and the rocks adjacent, since his arrival at the port. The number of registered vessels belonging to Castletown, from 15 to 105 tons, were 83, making a total of 1992 tons; and there were 47 licensed vessels under 15 tons. He further stated the number of vessels arrived at that port, in 1845, were 429; that the value of their cargoes had greatly increased since the passing of the fiscal bill, as the teas, sugars, wines, &c., were now landed there, which formerly were landed at Douglas.

The Harbour-master stated the number of vessels to have greatly increased since the passing of the recent fiscal bill, and that during the past year upwards of 400 vessels had entered the port.

No. 150.

Account of fishing vessels frequenting the Harbours.

No. 150.

Memorandum of Fishing Vessels frequenting the Harbours of the Isle of Man, their Crews, &c. &c

286 Boats following the Cod and Herring Fisheries.
278 Yawls that follow the Inshore Fishery.
45 Smacks that run fresh and bulk fish to Liverpool and other ports.

609 belonging to the Isle of Man, manned by 4,077 men.

APPENDIX B.

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No. 150.

Account of fishing vessels frequenting the Harbours.

The tonnage of the 286 Boats and 45 Smacks is		5,143 tons.
The value ,, ,,		£ 63,945
,,	Nets	18,792
,,	Lines for Cod fishing . .	690
		£ 83,427

The Tonnage and Value of the Yawls not ascertained.

In addition there are about	50 Irish vessels running fish	(6 men each)		300
,, ,,	45 Welsh and English ,,	4	,,	180
,, ,,	200 Irish fishing boats . .	8	,,	1,600
,, ,,	200 English ,, . .	8	,,	1,600
Total . .	495 vessels	Employing .		3,680 men

employed on the Coast of the Island during the fishing season, and consequently frequenting its Harbours, in addition to the 609 vessels above mentioned.

The Harbours on the West Coast of the Island will not accommodate half the above, neither Peel nor Port St. Mary can contain a quarter of the above vessels; and it is certain that the deficiency of Harbour accommodation prevents the extension of the fisheries; the risk of life and property being great, even where there is Harbour room for the vessels, but much greater where there is a deficiency, and that to so great an extent as to prevent parties embarking in them.

[For the Official Return see p. 266.]

No. 151.

No. 151.

Rennie, on the contemplated Improvements in the Harbour.

Report of Sir JOHN RENNIE, F.R.S., *on the contemplated Improvements in the Harbours of the Isle of Man.*

MY LORDS,

London, 19*th March*, 1838.

In compliance with the direction of your Lordships, communicated to me by Mr. Spearman's letter of the 28th of March last, respecting the contemplated improvements in the Harbours of the Isle of Man, I beg leave to observe, that the designs and the consequent expense of the works will necessarily depend upon the extent to which they are carried, whether merely for the purpose of accommodating the local trade of the respective ports, or whether for more extended commerce with foreign ports or for affording asylums to vessels in distress in the Irish Channel when driven by stress of weather on the coast. The original intentions and instructions of the local authorities to me were to confine the improvements to Castletown, Derby haven, Douglas and Ramsey, and to design them upon a scale adapted only to the local demands of these respective districts, and in the event of works upon a larger scale being contemplated, they should form a subject for future consideration.

With this view I have prepared the accompanying designs and estimates for the improvements of the 4 ports above-mentioned, which I now beg leave to submit for your Lordships' consideration.

Castletown.

CASTLETOWN.—This port is situated on the North side of a bay at the South-western extremity of the island. The Bay is 1½ miles wide at the entrance, 1¼ at the upper end, 1¾ miles deep, having a bearing of N. E. and S. W. The soundings taken in a line across the mouth of the bay from the Skerrane to the Scarlet Stack vary from 17 to 75 feet at low water of spring tides, decreasing from thence gradually to the low water line at the upper end of the bay. The bottom towards the mouth is generally rocky, and there are 3 rocks or shoals dry at low water, the largest of which, "Lheeahro," is a quarter of a mile long and 500 feet wide. There is a strong current setting right across the entrance of the bay in an easterly direction, commencing with the ebb and continuing until half flood at the rate of 2¾ miles an hour as far as "Skerrane's Point" then increasing to 7½ miles an hour; the current during the remainder of the flood takes an opposite direction to the northward nearly of the same velocity: between the outer current and the upper end of the bay there is an eddy or counter current decreasing gradually in strength until it almost ceases to be perceptible.

Spring tides rise 18 feet and neaps 12 feet. The bay is exposed from S. W. to S. E., or 8 points of the compass; but during westerly winds also, which prevail nearly 9 months in the year, a heavy sea sets in. This, combined with the strength of the currents, and the shoals and rocky bottom, render the bay unsafe as an anchorage; it is consequently rarely resorted to by vessels except those of a small description bound to Castletown. The present harbour is formed by a small stream passing through the town of Castletown and discharging itself into the northern side of the bay about a mile from the entrance. The mouth of the stream is protected from the westward by a small pier about 270 feet long with a lighthouse at its extremity. The tide ebbs 11·40 from the extremity of the pier, so that the harbour is completely dry at low water; at high water of neaps there is only 9·6 in at the pier and 13·6 in at springs, consequently it is only frequented by a few small fishing boats and sloops.

These however, are much exposed during southerly and westerly storms from the inadequate protection afforded by the pier, so that for the most part it is only frequented during fine weather and during the prevalence of easterly gales. A large proportion of the trade of imports and exports is carried on at Derby haven, about a mile distant, where in consequence of the superior accommodation afforded by that bay, it is considered preferable to be at the extra expense of land carriage to and from it to Castletown, rather than encounter the risks and difficulty attendant upon that port. For this reason Derby haven may be considered as the principal port of Castletown and although no doubt it is practicable to make a much better port at Castletown for that object; and by the outlay of a considerable sum of money, and (I accordingly prepared designs upon a large scale), nevertheless, for the reasons above stated, I do not consider it advisable to do more at Castletown than necessary to accommodate the few vessels of a small class which now frequent it, by giving them that protection which at present is so much wanted. The great objection to the present harbour is the want of protection during southerly and westerly storms; for this purpose I would recommend that the present pier should be extended 25 to 30 yards in its present direction, and then 50 yards in an east south-east direction, which would bring the head within the protection of the Skerrane's Point, and thus throw off the sea which now sets in from that exposed quarter. The rocks lying within the pier so extended should be excavated down to the level of low water for about 100 yards wide, using the rocks so excavated for filling the interior of the pier: the excavation should be continued from thence to low water mark of spring tides. These additional works, which are described in Red on the accompanying plan, would not only render the whole of the present harbour available during storms, but would also give increased accommodation and shelter, and enable vessels to approach and depart with much greater facility than they now do, and would in fact give all that accommodation which the trade requires without encountering the expense of larger works, which would be bestowed with better effect elsewhere. The estimate to carry into effect the work above recommended would amount to the sum of 4,500*l.*

Derby Haven.

DERBY HAVEN, with its fine bay is situated 8 miles to the southward of Douglas Head, and near to the southernmost extremity of the island: it is bounded on the north-east by the bold and precipitous promontory called St. Ann's or Kirk Santon Head, composed of clay slate nearly 200 feet high, and on the south side by a small rocky island called Fort Island, which is connected to the main land by a causeway and breakwater which prevent the tide from passing through (and upon this island is a small lighthouse.)

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Rennie, on the contemplated Improvements in the Harbours.

The distance between these headlands is about 3½ miles, and the depth of the bay taken from a line drawn between them is nearly a mile; but that part of the bay which more properly forms Derby Haven is situated at the southernmost extremity of the grand bay, and may be reckoned only half a mile wide, and three-quarters of a mile deep at high water; it is directly exposed to the east, and is open from north-east to south-east, or 8 points of the compass, and when gales set in from this quarter, the sea is necessarily very heavy, and vessels taking refuge here on such occasions are exposed to considerable danger, so that except during westerly winds it cannot be termed safe in its present condition. Ordinary spring tides rise 18 feet, and neaps 12 feet, and equinoctial or extraordinary spring tides 21 to 22 feet.

The main current of the flood comes from the southward, and the ebb from the northward, and extends outwards about half a mile eastward from the Fort Island, and at the height of spring tides sets past at the rate of 3 to 4 miles per hour, whilst at neaps its velocity is reduced to nearly one half of the above.

The counter or bay current commences close in shore soon after high water, and sets to the northward at the rate of 3 miles per hour, and continues until half flood or 9 hours, and when it reaches St. Ann's Head, it there joins the edge of the main ebb current and turns to the southward, setting directly past the extreme point of Fort Island, where the current runs along the eastern side of Langness Point from half flood to low water or nine hours, but from low water to half flood there is no perceptible current either ways at Fort Island point or in Derby Haven. The general depth at the entrance taken at right angles to Fort Island varies from 26 to 47 feet at low water of spring tides, and decreases gradually from thence to low water mark. The bottom for the most part is sand resting on a bed of marl, and forms good holding ground. The surrounding coast about St. Ann's Head is bold and precipitous, being about 150 to 200 feet in height, descending from thence gradually to the lime kiln at the entrance to Derby Haven to about 20 feet above high water; and so far as Kirk Santan Creek, in the above district, a distance of near 2½ miles, the rocks are composed of argillaceous schist. From Ronaldsway to Fort Island the shores are mostly flat, and there is plenty of fine lime-stone fit for building, and about the same average level above high water.

The upper end and head of the haven has an extremely flat shelving shore between high and low water marks, and ebbs dry nearly a quarter of a mile, and is only separated from the bay of Castletown by a narrow flat neck of land about 200 yards wide. The southern shore of the bay and the whole of the peninsula extending from Fort Island to Langness Point are composed of schistose rocks similar to those of Douglas Head.

From the above description of Derby Haven, its outer bay and surrounding shores, it may with propriety be termed an excellent natural harbour, and possesses considerable advantages, whether as regards its general situation with respect to the Irish Channel, its depth of water, its extent and capability of improvement, or the fine materials of which its shores are composed, and which are well calculated to carry any improvement into effect.

It is clear, however, before Derby Haven can be rendered either fit for an asylum harbour at all hours of tide and during all weather, or even for a tidal harbour, considerable artificial works and improvements will be necessary.

As my present instructions however are confined to the formation of a tidal harbour suited only to the wants of Castletown and the surrounding districts, as well as for the protection and accommodation of a numerous fleet of Irish and Manx fishing boats of about 20 tons burthen, which frequent it annually for fishing, I will proceed to describe what is necessary for that purpose, leaving the asylum harbour to a future opportunity when required. Towards the upper end of the bay, near to Ronaldsway and the Smelt House, there are two reefs of rocks projecting out from the shore at right angles, and enclosing a large open space, nearly free of rocks within, to the extent of 2700 feet long, and 1400 feet deep, having an entrance about 400 feet between the extremities of these rocks. The highest part of the reefs is only six feet below high water of spring tides, they consequently, even at present, form a considerable protection to the space within, so that vessels frequently discharge their cargoes here, which are carted to Castletown, a mile distant.

This spot, therefore, under all the circumstances, seems particularly well adapted for a tidal Harbour. For this purpose I would recommend that two breakwater piers should be constructed upon the highest parts of the reefs of rocks above mentioned; and as they will be probably too far situated, and require considerable expense to make them landing piers as well as breakwaters, they need not be carried more than two or three feet above high water of spring tides, and may be considered only in the light of breakwaters to keep off the sea; and for the purpose of loading and unloading cargoes, a jetty might be constructed near the centre of the Harbour in the position marked on the drawing; this should be carried out, so that there be generally ten feet at high water of neap tides, which would be sufficient for the purposes of the local trade.

The expense of the two Breakwaters (assuming the rocks to be six feet below high water of spring tides on the average), would amount to 14,600*l.*, and the jetty 3000*l.*, or 17,600*l.*

This would make a very safe and complete tide Harbour, perhaps on a larger scale than absolutely necessary; but on account of the situation of the rocks, which would form the basis of the piers, very little would be gained by making it less. The jetty might be dispensed with by making an equivalent portion of landing accommodation upon either of the Breakwater Piers; but as this would render it necessary to carry the breakwaters higher above high water, and to construct parapets and quay walls, no saving therefore would accrue upon the aggregate estimate, and an extra distance of land carriage of from half to three quarters of a mile would be necessary, which would, of course, occasion delay and extra expense in loading and unloading cargoes. If, however, it should be deemed advisable that the jetty should be dispensed with (which perhaps, under the circumstances, had better be done), the quay would be more convenient if made on the eastern breakwater: upon the whole, therefore, in either case, a very convenient, capacious, and safe tidal Harbour would be made; and, considering its extent and advantages, at a very moderate expense, and would certainly be extremely beneficial to this part of the island, and to the great numbers of Irish and Manx fishing vessels which annually resort here, as well as to merchant vessels which are frequently driven in by distress.

Douglas.

DOUGLAS Harbour has for some years been improved by the erection of an extensive pier on the north side of the harbour; but is still defective in consequence of the entrance being much exposed to the eastward, and during gales from that quarter a considerable swell sets into the harbour so as to produce much agitation within and occasion great inconvenience to vessels stationed there. In order to remedy this evil, I recommended a small work to be constructed below Saint Ann's Fort, which is now in progress, and will, I have no doubt, have the desired effect as far as it goes; but in order to make the entrance complete, other works will be required, the whole of which are estimated at 6800*l.*

For further particulars as to this work, if required, I beg to refer your Lordships to my Report of the 2nd April, 1835.

Ramsey.

RAMSEY Harbour is situated at the northern extremity of the island, near the middle of the extensive bay nine miles long and three miles deep, bounded on the south by Maughold's Head, and on the north by the Point of Ayr. The shores on the south side are composed of lofty, rugged, and precipitous schistose cliffs, with deep water close to them; towards the centre the bay is flat and alluvial; thence from near the high-water mark is bounded by sandstone cliffs, thirty feet high, as far as ; and from thence to Point of Ayr the shore is formed by a deep shelving and moveable beach. The soundings taken in a line between Maughold's Head and the Point of Ayr vary from twelve to twenty-eight feet at low-water of spring tides, from thence decreasing very gradually to the centre of the bay, where the tide ebbs about four hundred yards from high-water mark.

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The bay is exposed from N. to S. E., or about twelve points of the compass; but the worst seas are from E. N. E.; from thence to the Point of Ayr considerable protection is derived from the Bahama Bank. The anchorage ground is good, and is much resorted to by vessels during gales from all winds from S. W. to N.; but during easterly winds it is much exposed, and a heavy sea sets in, which renders it unsafe. The current of the first of the flood at the Point of Ayr takes a south-east direction, and at springs the velocity near half flood is about six miles per hour, and the ebb current attains about the same velocity. The best anchorage in the bay for vessels is where the lighthouse bears W. N. W. two miles and a half distance, and Maughold Head bearing S. by E., and the point of Ayr N. by E., and the soundings three and a half to four fathoms at low-water in good holding ground; in fact, there is no foul ground in the bay. The town of Ramsey is situated near the centre of the bay on a large flat point of land, bounded on the north by the small stream of that name, which forms the present harbour, which, after passing for several miles through an extensive fertile agricultural district, discharges itself into the bay at the north side of the town. This river or stream is extremely circuitous, tortuous in its course, and in passing by the town forms a complete horse-shoe bend, which is surrounded by rough stone quays, upon which the commerce is carried on; from thence to low-water mark it meanders through the extensive sands, and is constantly shifting its course. The entrance of the stream into the bay, which lies almost due E., has been in some measure protected on the south side by a small pier, 200 yards long, projecting out at right angles to the shore; but even this, combined with the stream, are so inefficient, that the easterly gales continually obstruct its waters by the accumulation of extensive sands in its course, so that the channel, after passing high-water mark, necessarily becomes extremely tortuous, and is compelled to shift its course to the north or south more or less according to the prevailing easterly winds and freshes. Spring-tides arise from nineteen to twenty-one feet and neaps from eleven to fourteen feet, but extraordinary tides, twenty-four to twenty-seven feet. The depth of water round the lighthouse varies from twelve to fifteen feet, and from seven to eleven feet towards the entrance of the lake.

The trade of Ramsey is perhaps among the most considerable in the island, as it is backed by the most extensive agricultural fertile districts, and being in the main track of the steamers and other vessels which trade between England, Scotland, and Ireland, its imports and exports are also consequently very considerable, and it is much resorted to also on account of the excellent anchorage and fishing station. From what has been stated above, it appears that the principal defects of the harbour have evidently arisen from the want of protection to the entrance of the river, so that the effects of the tidal and fresh waters in maintaining a regular deep channel to sea are completely overpowered by the prevailing easterly winds and the extensive tracts of shifting sands, and consequently the public and private advantages which otherwise would result from the harbour are greatly diminished.

The direction of the south pier, which no doubt was intended in some degree as a remedy against this serious evil, as well as to protect the town, has been rendered in a great measure abortive in consequence of its wrong direction; still, however, to a certain extent, its effects are beneficial, as it confines the current, and enables it to set more effectively upon the sands in its passage towards low-water mark. I, therefore, perfectly coincide in the opinion of the late Mr. Rennie, who, in his Report of the 12th May, 1814, recommended that in order to provide a remedy against this evil, a pier should be constructed on the south side and continued in a N. E. by E. direction towards low-water mark; that another smaller pier on the north side, aided by several low-water jetties, should be carried out from the north shore at right angles to the south pier or parallel to it, having a space between it and their extremities of about 150 feet wide between the extremities of the two piers, and increasing from thence to low-water to about 200 feet, more or less, as may be required; these would have the double effect of confining the course of the river to one position and direction, and by preventing it from being obstructed by the sands, it would be enabled to preserve an effective and deep channel to sea, and thus materially improve the harbour so as to admit vessels of larger burthen and in greater numbers than now. The expense of these works will necessarily depend upon the extent to which they are carried: in order to complete the design, they should be carried out to low-water mark of spring-tides; this, however, would probably be attended with more expense than could be obtained. I have, therefore, confined the design in the first instance to low-water of neap tides, this would require 19,500*l*., although if half that sum was to be expended upon the same principle, a considerable degree of benefit would be derived which would well justify the expenditure, and in the event hereafter of funds being obtained, the works would be carried to the fullest extent.

If works upon a more extensive scale, so as to give accommodation to vessels at low-water, should be required, I beg to refer your Lordships to another Report, where I have fully discussed the subject.

RECAPITULATION.

Statement of the various estimates required to complete the works mentioned in the foregoing Report for the Improvement of the Harbours of Castletown, Derby Haven, Douglas, and Ramsey.

Castletown	4,500
Derby Haven	17,600
Douglas	6,800
Ramsey	19,500
	£48,400

I trust that in the above Report I have clearly understood and strictly complied with your Lordships' wishes, and shall be ready to furnish any other information that may be required. The design for the various harbours above mentioned have been prepared with a view to the strictest economy, and considering the peculiar circumstances attached to each, I do not think it would be advisable to attempt them upon a smaller scale, and judging from the resources of the island and its peculiar situation in the middle of the Irish Channel, which makes it the resort of almost all classes of vessels, I am inclined to think that the expenditure of the various estimates above mentioned would be attended with an adequate return. I have also considered the practicability of constructing larger or low-water asylum harbours at the several ports of the island, and have prepared various designs for that purpose which will be ready when called for. These works would necessarily involve a much larger expenditure, and would only be contemplated in the event of the general trade of the Channel connected with Liverpool, Dublin, Belfast, Glasgow, and the other great ports, calling for more accommodation in this quarter. An excellent low-water asylum harbour, either upon a small or large scale, could be constructed at Douglas with great effect and public advantage, as it may now be termed the principal port in the island, and the head station for the mail packets, which certainly require more accommodation and protection than can be given by the present tide harbour, and from the want of which, during easterly gales which frequently occur, they, as well as numerous merchant vessels resorting there, are often exposed to imminent danger, and several wrecks have occurred which would have been avoided if a proper outer harbour had been constructed there, and which, if made upon a moderate scale, might be completed for a comparatively small expenditure, which would soon repay itself, and, as such, is well worthy of consideration. I beg to conclude by adding, that when applied to some time ago by the local authorities of the island, that presuming there was only a sum of 18,000*l*. to be expended altogether, I would recommend that 6000*l*. should be laid out at Castletown and Derby Haven, 7000*l*. at Douglas, and 5000*l*. at Ramsey, in carrying into effect the various plans which accompany this Report, which would be

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extremely beneficial as far as they would go; although it should be distinctly understood, that in order to complete them and produce the full effect desired, the whole of the respective estimates stated in the former part of this Report will ultimately be wanted.

I have, &c.,
JOHN RENNIE.

To the Right Honourable the Lords Commissioners of Her Majesty's Treasury.

No. 152.

No. 152.

Denham, on a proposed Asylum Harbour in Douglas Bay.

Report of Captain H. M. DENHAM, R.N., F.R.S., *on a proposed Asylum Harbour in Douglas Bay, Isle of Man.*

SIR,

Liverpool, 31*st October*, 1835.

Pursuant to a minute of the Dock Committee dated the 6th instant, and in accordance with instructions from the Deputy Chairman to the following effect:—

"To see how far the interests of the Merchants and Ship-owners of Liverpool may be affected by the proposed Safety Harbour at Douglas, Isle of Man, in reference to the proposed situation being well calculated for affording shelter to the shipping of this port in cases of distress or strong adverse winds, which compel them to look out for a place of safety; and if so, whether the plan proposed, or the enlarged plan suggested, would afford that ready and safe harbour required; and further, to what extent would either the one plan or the other, give the required shelter, for the shipping of this port;—bearing in mind that vessels from Whitehaven and the other northern ports, as well as the craft of the Isle of Man, would certainly occupy a portion of it."

I proceeded on the 22nd instant accordingly, and during the 23rd, 24th, 25th, and 26th, availed myself of the low ebbing of spring tides and intermittent gales from the south and west, in examining the coast feature and water space of Douglas Bay; also taking a comparative view of Derby Haven.

I satisfied myself that Douglas Bay, in point of locality, capacity of water, surface, area, natural features, and freedom from contiguous danger, is a fit position for forming a Safety Harbour, as a *Central Refuge* for vessels navigating the Irish sea: *Provided all* the space which Douglas Head covers to the south-west is embraced by breakwater projections on the south-east and north-eastern aspects, equivalent, if not precisely according to, the outline features portrayed on the tracing herewith submitted; wherein I propose a slightly curved arm direct from Douglas Head on a north-east-by-east trend 1900 feet long, based in 53 feet water at low water springs, with its extreme overlapping that of another arm direct from Saint Mary's Rock, on a south-east trend 1400 feet long, based on a ledge of rock in 12 and 21 feet at low water; leaving an opening of 300 feet wide in the eastern aspect. Such an enclosure will yield an area of 80 acres at low water level spring-tides capable of berthing 50 ships of 18 feet draught, upwards, and 100 coasters of 9 feet draught, upwards, being 150 sail *afloat* in *self-berthing* and *swinging room*; besides the 80 coasters which the present dry harbour could secure if covered by outer works.

A less enclosure than I suggest, would not, in my opinion, give Liverpool that proportion of refuge space for her shipping interest, which ought to be in prospect to excite and warrant a voluntary participation in a general tonnage contribution. Though an asylum such as Douglas Bay is capable of presenting, might truly be contemplated as fraught with competent succour to the weather-beaten mariners, or those under adverse wind detention—contingencies that would not, it may be assumed, simultaneously accumulate more than 50 Liverpool ships; there would, however, be room for that number, independent of the probable resort of local craft and vessels from the surrounding ports.

Reverting, Sir, to the plan I have sketched, I should remark that, when proposing one entrance only, and that on the eastern aspect, I contemplate a safer ingress on westerly gales, inasmuch, that the arriving vessel would shoot up into a warping-berth with less risk of damage to herself and those already within, than if under the often ungovernable effects of a leading stormy wind; whilst by overlapping the mole heads, so as to turn the south-western sea off the entrance, an egress is available with any wind from either mole head I would stretch the south-eastern and paramount arm of this mole direct from, and connectedly with, Douglas Head; first, to avoid that expenditure of funds and time which isolated works of this nature entail, besides the havock they are exposed to from gales of wind whilst progressing between low and high-water levels, so contrary to the advantages of leading and shooting the material direct from the quarry—attaining and preserving the ultimate level above high-water mark; whereby every yard advanced produces a portion of actual shelter. Detached breakwaters present for years a formidable obstruction to hitherto clear water, of the nature of a sunken reef of rocks, however well buoyed off; secondly, a continuous line of work would repel and divert the insidious sea which twists round Douglas Head, even with a long shore wind, and which an adequate opening for ship entrance would so invite, as to produce turbulent water throughout the mole; nor do I consider (from the drift of ebb or the quantum of silt held in suspension which I observed), that a tidal thoroughfare would be essential; indeed, a deposit to a certain extent along the inner face of the arm would be acceptable, and should it exceed so as to require a tide gap it might be effected subsequently at trifling expense compared to the consequent results of detaching the body of the edifice to preserve an opening from the commencement at the cost and task of transporting every stone. I would further remark in reference to the cross or north-eastern arm, that so much shelter is promised by the south-eastern as to render the former a matter of ulterior design to perfect the mole; if so, I conceive the exposed aspect of our enlarged plan would be covered at less expense and time than the inadequate space proposed under cover of a detached structure; indeed, our single entrance or point of rounding would require but one light-house, which, blended with the different disposal of material, goes to compensate the basing on ground 13 feet below that proposed by Sir John Rennie.

Presuming, Sir, that the importance (to life, merchandise, and wear and tear of shipping) of such a refuge has been made manifest by the able comments of Sir William Hillary and Sir John Rennie—alike in reference to a rendezvous for His Majesty's cruisers.—I will conclude this report by subscribing myself,

Your obedient servant,
H. M. DENHAM.

To William Foster, Esq., Secretary to the Dock Trustees, Liverpool.

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No. 153.

Rennie, on an Asylum Harbour in Douglas Bay.

Report of Sir JOHN RENNIE, F.R.S., *on an Asylum Harbour in Douglas Bay, Isle of Man.*

GENTLEMEN,

London, 2*nd April*, 1835.

In consequence of your instructions, I have examined and surveyed the Bay of Douglas, with a view to the formation of a low water asylum harbour, capable of affording ample accommodation for all classes of vessels at all times, when unable to keep the sea on account of adverse winds, storms, or other accidents, and I now beg leave to lay before you the following result of my observations.

The want of a central asylum harbour in the Irish Channel, to which vessels of all descriptions, whether outward or inward bound to and from foreign ports, or employed in the Revenue Service or coasting trade, could resort at all times of tide, and during all winds, has long been severely felt; and the numerous and disastrous shipwrecks which have already taken place, and still occur every year,

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attended with the lamentable destruction of human life and property in this channel, seriously call for a remedy. Considerable light has been thrown upon the subject, and much valuable information has been obtained, by Sir William Hillary, in his Pamphlet of July, 1826; wherein he points out Douglas Bay as the best station for such a harbour, and invites the attention of Government, as well as of the important shipping interests of Liverpool, Dublin, Whitehaven, Lancaster, and the coasts adjacent, to this interesting subject. He there states, with truth, that there is no low water harbour of any magnitude between Holyhead and the Firth of Clyde, except the packet harbour of Whitehaven and Port Patrick, a distance of upwards of 300 miles, on the east side of the Channel: whilst on the Irish coast, with the exception of the packet harbours of Ardglass, Donaghadee, and Howth, there is no considerable port of refuge between Kingstown, in Dublin Bay, and the Lough of Belfast. From hence it arises that vessels outward bound from Liverpool, when prevented from continuing their voyage by strong westerly winds, are driven back, and are compelled to beat about the Channel during long nights and stormy weather, at the imminent risk of shipwreck, and even under the most favourable circumstances, are subject to great detention and expenses of wear and tear. The attempt to run hack to Liverpool might be attended with still greater difficulties, in consequence of the numerous dangerous and formidable banks which surround the mouth of the River Mersey in all directions for many miles to seaward, and the impracticability of entering at low water, or even sometimes at high water, particularly during the night, and dark and stormy weather.* The large fleets of colliers from Whitehaven, Workington, and the coast adjacent, from 70 to 100 and upwards of which sometimes leave those ports at one tide, and by which Dublin and a large portion of Ireland are supplied with coal, experience similar difficulties in their voyages, and frequently suffer shipwreck for want of a proper port of refuge to run to in event of need.

Upon a careful consideration of the chart of the Irish Channel, and more particularly with reference to the important port of Liverpool, and the populous surrounding country, whose yearly imports and exports are so immense and continually increasing,† it plainly appears that the Isle of Man occupies the most central position, and lies, as it were, in the main track of all vessels proceeding from and returning to Liverpool by the north entrance to the Irish Channel, as well as of the immense intercourse by steam between Scotland, Ireland, and England, and of the extensive fleets of colliers, and other vessels, from Whitehaven, Workington, Allonby, Maryport, and the towns on the Solway Frith, to Dublin, Drogheda, Newry, Belfast, and the adjacent coasts. The island, moreover, is easily accessible, particularly on the east side, in consequence of there being plenty of water close to the shore, with good holding-ground for anchorage, and no sunken shoals and rocks; so that during the prevalence of westerly winds, vessels usually take shelter under the lee of the Island, until they are enabled to proceed on their voyage. Notwithstanding these advantages, however, it frequently happens that, after a long prevalence of wind from the westward, it suddenly veers round to the eastward and increases to a considerable gale: at this period, the Island, which previously formed a protection to shipping, becomes the reverse, and a heavy sea sets in upon its whole eastern shore, so much so that vessels cannot ride with safety at their anchors, and as it is almost impossible for them to work to windward under such circumstances, they are frequently driven ashore and wrecked. In confirmation of the above may be mentioned the melancholy examples of the total loss of the American ship Minerva, at Douglas, when 18 out of 20 persons perished; in 1822, His Majesty's cutter Vigilant, the Racehorse sloop of war, the City of Glasgow steam packet; and only in November last, the Fairfield, bound to the Havannah, with a cargo valued at 40,000*l.*, was lost near Castletown; besides the Emulous, and several other coasting vessels riding at the same time in Ramsey Bay, during a strong westerly wind, which suddenly changed round to an E.S.E. gale, and in which eight lives were lost. In addition to these, many other and equally lamentable cases could be cited, all of which would have been prevented if there had been a proper asylum harbour to run to; and the values of the cargoes, and the vessels alone, besides the wear and tear of those keeping at sea, and the loss of time in being driven about the Channel, and the more important consideration of saving human life, would more than have sufficed to defray the expense of such a work. Its importance, therefore, in every point of view, either as regards the extensive and valuable shipping interests and trade of Liverpool, Dublin, Glasgow, Whitehaven, Belfast, and the numerous other ports in the Irish Channel, or the Isle of Man Fisheries (which employ 250 vessels, and upwards of 2000 seamen), is undoubted; and it only remains to point out what is the most advisable place and plan, together with the expense of such a work.

First. With regard to the place: the central position of the Isle of Man, from its being in the line of voyage of all vessels passing and repassing by the north entrance to the Irish Channel to and from America, as well as of the equally important and extensive communication between England, Scotland, and Ireland, the depth of water and great rise of tide close to its shores, and its being generally clear of rocks and shoals, points it out as a most convenient and accessible situation: and Douglas, being the centre and most populous part of the Island, and in other respects possessing the advantages above-mentioned, appears, upon the whole, extremely well adapted for an asylum harbour, such as proposed. I have, therefore, followed your instructions in preparing the plan accordingly; and I will now proceed to describe the different features and advantages of Douglas Bay, which will be better illustrated by the accompanying plan and chart, to which I beg to refer you.

The commodious and extensive Bay of Douglas is situated nearly in the centre of the eastern side of the Island, and about 18 miles distant to the north-east of the Calf of Man. Its extreme width, taken between Douglas Head on the south, and Bank's How on the north, is about 2½ miles; but, between Douglas Head and Quarry Point (which more properly speaking may be considered as the Bay), it is only 1⅜ mile wide, and ⅞ of a mile deep. On the north side, it is bounded by steep and almost perpendicular schistose rocks of clay-slate varying from 100 to 200 feet high, with soundings of from 2 to 5 fathoms at low water of spring-tides, close to the shore. The west, or upper side of

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* Among the numerous examples of shipwrecks which have occurred off Liverpool, may be adduced the Amity, Hosanna, Havannah Packet, Providence, Crisis from Philadelphia, Gipsey from Lisbon, Isabella from Belfast, Liverpool Packet from Savannah, Jane ditto, Supply from Whitehaven, Anna Maria from Rostock, Dee from Miramichi, Theodore from New Zealand, Mary from Ulverstone, St. Vincent for St. Vincent, Mona Aville from Isle of Man, Golden Fleece from Bolivia, Belgrave from St. Petersburgh, George Symes from Quebec.

† According to the Return of the Dock Duties, the number of vessels and the amount of tonnage were in the year ending 24th June, 1834, as follows:—

No. of Vessels	13,444 . . .	1,692,780 Tons
No. of Voyages of Steamers	2,281 . . .	401,631 Ditto
		1,291,237 Tons of Sailing Vessels.

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the Bay, is formed by a fine sloping shore, chiefly composed of sand mixed with a small quantity of shingle, interspersed with schistose rocks, which crop out above the surface, and become bare for some distance at low water, towards the northern side of the Bay.

The town of Douglas, containing about 8000 inhabitants, is situated at the south-west extremity of the Bay, and at the mouth of a small river of the same name, which, after taking its rise from the highlands about ten miles up the country, and passing through the town, discharges itself into a smaller bay within the great one above described, and which is formed by a ridge of schistose rocks, on the north side, called the Pollock Rocks, which ebb dry 800 feet beyond high-water mark in an easterly direction, and are about 15 feet upon the average above low water; and another extensive rocky shoal or island, dry also at low water for about 1000 feet in the same direction, upon a part of which, at the level of high water, a small tower of refuge has lately been built for the purpose of saving the lives of any persons who may be shipwrecked upon it. The last rock or shoal is called St. Mary's Isle, or the Connister Rock, between which and the Pollock Rocks there is a channel 100 yards wide, which, however, is left nearly dry at low water of extraordinary tides. The southern shore of the Bay, like that of the north, is formed by bold and precipitous cliffs, varying from 50 to 100 feet high, stretching for nearly half a mile in a south-east direction as far as Douglas Head, upon which a light-house has recently been erected, serving the double purpose of a channel as well as a harbour light. The present harbour is formed by a pier extending 650 feet long from high to low water mark, in an E. by S. ½ E. direction, and running parallel to the mouth of the stream above-mentioned, and is terminated by a circular head, having a smaller light-house erected upon it for the use of the harbour. Quay-walls are continued upwards from this pier, on both sides of the river, as far as the bridge, a distance of 1900 feet; but the tide extends about half a mile farther, although the bridge may be considered as the extent of the present harbour, and in which all the business is transacted. The whole of the above space, containing about 11 acres, is dry at low water of spring tides, and the bottom is composed of a fine shingle. The rise of the tides is, in a great measure, regulated by the prevalence of particular winds: generally speaking, however, the height of the springs occurs two days after full and change of the moon at noon, when the tide rises from 19 to 20 feet, and extraordinary or equinoctial tides rise 22 to 23 feet; and at neaps from 10 to 14 feet; so that vessels of 150 to 300 tons can always enter the harbour with a moderate tide at high water. From the circumstance of the junction of the main tide from the Atlantic, which enters by the north and south entrances to the Irish Channel, taking place in a line drawn in a W.S.W. direction through the centre of the Island, there is a very little difference in the time of high water at the various ports of the Island, which seldom differs more than from six to fifteen minutes.

Corresponding with the form and situation of the Bay, there are several currents. The main or offing-current, on the ebb, commences about a quarter of a mile from Bank's How, with a south-westerly direction until it arrives at about half a mile from Douglas Head: it then runs south-by-west, and when at its greatest strength, attains a velocity of two miles per hour; and *vice versâ*, the flood current, which is equal in duration to the ebb—viz., six hours, proceeds northward at the same velocity—viz., two miles per hour at springs; but during neaps, both flood and ebb cannot be estimated at more than one-half of the above velocity, or one mile per hour. The in-shore current on the ebb commences at Bank's How one hour before high water, and pursues a westerly course until it reaches the centre of the Bay, where it divides into two currents—the one passing between St. Mary's Isle and the shore, at the rate of three-quarters of a mile per hour, and the other on the outside, at the rate of 1¼ miles per hour. These two currents unite again, after passing the Island, and proceed past Douglas Head; and when they arrive at a short distance outside the Head, they attain the velocity of 2¼ miles per hour; and on the flood, the in-shore current commences at Douglas Head a little before low water, and makes direct for Bank's How and Clay Head, at the rate of three-quarters of a mile per hour, and so continues until within one hour of high water, when the ebb commences as before.

In addition to the above current, there is also another commencing at half-flood a little inside of Douglas Head, and setting outwards at the rate of half a mile an hour.

The direction and velocities of the currents above mentioned must be considered as taken during moderate tides and weather, but, as may be naturally supposed, are influenced to a certain degree by particular winds, and various other causes.

The bottom of the Bay, for the most part, is clear of rocks, except near the shores on the north side, as above mentioned; and there is good anchorage, in a sandy and clay bottom, in seven fathoms and upwards at low water. The Bay may be termed exposed or open from the N. E. to S. S. E., or ten points of the compass; but the south-east wind, which sets directly into the Bay, may be considered the most dangerous quarter, and gales not unfrequently occur from this point, which produce the heaviest sea, and have frequently been attended with the most disastrous consequences to the numerous vessels and their crews which frequent this port. Moreover, during such occasions, the present harbour is much agitated, particularly near the new pier; so much so, that vessels lie very uneasy, and, as the tide rises and falls, strike the ground with considerable vehemence, and, in consequence, at times suffer materially. This evil has, moreover, much increased since the removal of the rocks opposite to the pier-head, which formerly acted as a jetty or breakwater, and partially prevented the waves from entering; whereas now they rush past the pier uncontrolled, and produce the bad effects above-mentioned. The Bay and Harbour, therefore, cannot be considered safe under these circumstances; but during westerly winds, being a weather shore, they are tranquil, and afford excellent accommodation for all classes of vessels.

Secondly.—Such being the present state of things, the next point to be considered is the most advisable plan for improving it; and with this view I have prepared the accompanying design.

Every design for an artificial asylum harbour should be constructed so as to embrace the following advantages:—

1st. Protection against the dangerous winds.

2dly. Facility of access and departure for the largest vessels at all times of the tide, and during nearly all winds.

3dly. Free circulation for the natural currents of the tide, in order that the due maintenance and preservation of the harbour, after having been made, may not be endangered.

4thly. Space sufficient to accommodate any probable number of vessels that may take refuge therein.

Conceiving that a large work of this description should be viewed more in the light of an asylum harbour for the general trade of the Channel, than merely confined to the wants of the Island, I have prepared the plans according to the foregoing principles, and upon a large scale, not doubting but that, if ever the work should be carried into effect, assistance will be obtained elsewhere.

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The plan which, under all the circumstances, appears to me most applicable, and upon such a scale as most likely to embrace the various objects contemplated, is as follows:—

1st. To construct a breakwater pier, 340 feet long, extending in a north-east direction from the Two-Gun Battery within Douglas Head; 2d, To construct a detached breakwater, 1400 feet long, composed of three kants or arms, bearing generally north and south towards St. Mary's Isle, leaving an entrance of 100 yards wide, more or less, in the clear at each end, the southern entrance having 34 feet, and the northern 21 feet at low water of springs tides; 3d, To run out also a small pier, 400 feet long, upon the south-east point of St. Mary's Isle to meet it.

By referring to the annexed chart, where the design is described in red, it will be seen that the breakwater and accompanying piers are so designed as to comply with the above conditions. For, as regards the first condition, viz., protection, the breakwater and its accompanying piers will form an effectual barrier against the dangerous winds from the eastward, which now constitute the chief objection to the security of Douglas Bay, and for the want of which the shipwrecks above-mentioned have occurred. And as the bay is well sheltered from all other quarters of the compass, if ever the above-described work should be completed, an excellent asylum or port of refuge would be obtained in the very centre of the Irish Channel, to which all classes of vessels could resort at all times, and lie in security when driven back by contrary winds, or disabled by storms, and be ready to proceed to sea whenever circumstances would permit.

With regard to the second condition, viz., facility of entrance and departure at all times. As there would be two entrances, the one to the eastward, having 34 feet, and the other to the northward, having 21 feet at low water of springs tides, scarcely any case could occur where vessels could not find access to the harbour; for instance, when driven back by a strong westerly wind, they would approach under the lee of the Island, and in smooth water could take the east or north entrance, as might be found most convenient; and during an easterly wind they would enter before it, and even, if disabled, would find no difficulty in making the entrances. Again, from the circumstance of the land here being the most prominent on this side of the Island, on departing in an easterly wind, when fit to put to sea, they would take the northerly entrance, and might, in most cases, lie close enough to clear the land without tacking; and during westerly winds, if proceeding to the eastward, they could take either entrance, and, as there would always be plenty of water, they could never be detained whenever the wind and weather might be favourable for them to pursue their voyage.

With regard to the third—The entrances being nearly in the direction of the counter-currents of the Bay, no material interference with them would take place. They consequently would not be deflected from their natural course, and thus the sediment which they hold in suspension, whether brought from the surrounding coasts or from the river and town of Douglas, would be transported to sea, as at present, instead of accumulating within the harbour, and thus tending towards its deterioration: this principle in the construction of artificial harbours is of considerable importance, and should not be lost sight of, wherever practicable to carry it into effect without militating against other and more important principles, which ought also to enter into the calculation. This becomes the more necessary, because, from the experiments of my assistants, Messrs. Combe and Smeaton, in Douglas Bay, it appears that there is a tendency to accumulate alluviæ, which should therefore be avoided where practicable. It may perhaps be argued, that the outsetting-current through the east entrance might be so increased as to impede a vessel's way in making for the harbour. This, however, I do not think would occur to such an extent; because, inasmuch as at present the strongest current is immediately outside of Douglas Head (where it increases to 2¼ miles per hour), and as it would not reach that velocity in either of the entrances, a vessel in any case must necessarily pass the stronger current outside before reaching the harbour, and with even but moderate way upon her would experience no inconvenience. This current, moreover, through the entrances would always keep them clear, and check the tendency of waves to enter the harbour during storms. Moreover, vessels would always have the opportunity of taking either entrances, as circumstances might render most advisable.

With regard to the fourth—The extent and accommodation of every asylum harbour should be regulated by the probable number of vessels which might have occasion to take shelter there at any one period; and considering the circumstances under which vessels run for a harbour of this description, frequently in large fleets, many of them disabled, and consequently not under control, much greater space must be given to them to bring up in than what would be necessary in a close dock or harbour adapted to a different purpose. Viewing the question in this light, and that the whole shipping interest of the Irish Channel is concerned, I scarcely think that accommodation for less than 150 to 200 vessels of all classes at low water would suffice. I have therfore planned the harbour upon this scale. The space enclosed within the breakwater and two piers would be about 45 acres, having a depth of from 1½ to 6½ fathoms at low water of springs tides, which, after allowing sufficient space for entering and anchoring, would accommodate about 200 vessels of the largest class of merchantmen, including King's vessels, in complete shelter, which could enter at all times of tide, during all winds, whenever they could approach the coast, and depart with equal facility, whenever it might be prudent to put to sea.

The works above described are chiefly intended as breakwaters, and as such would not require regular masonry except at the entrances; they would be formed by rubble in a substantial manner, raised sufficiently above high water, with proper moorings and buoys distributed over the space enclosed within, so that vessels might bring up and fasten to them. The south pier, under the Two-gun Battery, might be provided with an inner quay-wall and parapet hereafter, if necessary, and be connected with the town by a road along the shore, so that steam-boats and merchant-vessels, when disabled, or otherwise, might land their passengers and discharge their cargoes. The north pier might also be converted to a similar useful purpose by connecting it with the shore by a work of an open description, which would leave the counter-currents before alluded to unobstructed.

A harbour of the above description, with two entrances, I consider in the present instance much better adapted to the situation and the various objects in contemplation, than one with two piers having only one entrance.

The estimate for carrying the above plan into effect would amount to the sum of 215,652*l*., and could be increased or diminished with a corresponding addition or deduction to or from the work; although, considering all the circumstances, the plan above described will probably be most likely to answer the various interests concerned.

Having now thus, I hope, clearly demonstrated the importance of the subject in every point of view, as well as the advantageous situation of the Isle of Man for such an undertaking, together with all the various circumstances connected with it, I beg to observe, that, with regard to the most proper

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mode of raising funds, as this work cannot be considered in the light of a local harbour, but one in which the whole trade of the Channel is more particularly interested, the co-operation and assistance of Liverpool, Dublin, Whitehaven, Belfast, Glasgow, and the surrounding ports, should be requested in order to carry into effect such a great and desirable object, the want of which has long been so universally experienced, and is every year becoming more so, in consequence of the increased navigation in the Irish Channel. Judging, therefore, from the losses which have already occurred, and of those which are likely to take place, unless some remedy be adopted, I am perfectly satisfied that the saving of valuable property from shipwreck, as well as of human life, which would result from the construction of such a port of refuge as above described would, in a very short period, produce an example remuneration for the sum expended.

I have, &c.,
JOHN RENNIE.

To His Excellency the Lieutenant-Governor, &c.

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No. 154.

Report by JAMES WALKER, Esq., C.E., F.R.S., *on the Improvement of the Isle of Man Harbours.*

SIR,

London, May, 1839.

A letter from Mr. Spearman, of date 23rd July last, informed me that the Lords Commissioners of Her Majesty's Treasury, having had before them a memorial from the commissioners for maintaining and improving the harbours of the Isle of Man, together with plans, estimates and other papers relative thereto, were of opinion that, before giving "authority in any manner for raising money to be expended on these harbours in the mode suggested by the commissioners, while it appears that a much larger sum would ultimately be required for other more important improvements, it would be necessary, in the first instance, that they should be satisfied of the propriety of taking the course recommended; and as to whether—

"First—The works the commissioners are desirous of undertaking would accomplish the object in view, without interfering with those further and more considerable improvements, should they be hereafter sanctioned;

"Secondly—Whether the works proposed can be effected for the sums named; and,

"Thirdly—Whether the intended plan of carrying them into effect is that best calculated for the purpose."

I was therefore desired to report my opinion; and various plans and papers were transmitted to me, with a view to assist my judgment on the above points.

Shortly after receiving this communication, I waited upon Mr. Spearman, and informed him that, without an inspection of the harbours and local information, not contained in the papers, it would be impossible for me to form anything like a correct opinion of the plans.

In September, I accordingly visited the island and surveyed the harbours: and in November, certain additional information, which I required from the authorities there, and without which, I had informed Mr. Spearman, I could not proceed with my report, was forwarded to me. These last communications have had my best attention; and I have been desirous, before reporting, to learn from the experience of a winter how far the pier, which was in course of erection on the south side of the entrance to Douglas harbour, when I visited the island, was likely to answer a good purpose. These causes have chiefly led to the delay that has taken place in giving in my report.

The different harbours, their situations and bearings, their natural advantages and defects, with the sets and currents of tides, have been fully described and explained in the several reports and plans which are before me; particularly in those of Sir John Rennie. For information of this general nature, therefore, I shall beg to refer to those reports, and think it unnecessary to trouble you with a repetition, unless when required to explain any point under consideration; more especially as my instructions are not general in regard to the measures I would recommend, but merely to report on the plans that have been prepared and recommended by Sir John Rennie.

To render my observations more explicit, I should here premise that there are two reports by Sir John Rennie. comprehending all the harbours. The first is a short report, dated June, 1836, accompanied by plans on a small scale; and states how the sum of 18,000*l.* may be appropriated most advantageously to the different harbours of Castledown, Derby haven, Ramsey, and Douglas. The other and more detailed report, dated 19th March, 1838, is accompanied by larger plans, and an estimate of more extensive works at the several harbours, amounting to 48,400*l.*; and one of the principal questions I consider to be referred to me by my instructions is, whether the execution of the smaller works will interfere with, or become useless, in the event of the more extensive improvements being sanctioned at an after period.

In addition to the above, there is a separate report on Douglas harbour by Sir John Rennie, in which it is treated as an asylum harbour, and works are proposed that are estimated at 215,652*l.*

I consider it proper, also, to state generally that, although the harbours are all defective, and all, I believe, capable of improvement, there was no where any appearance of the works being in a ruinous or dilapidated condition, such as to require a great outlay in repairs. On the contrary, I think credit is due to those in charge of them, for the attention that seems to have been paid to keeping them in repair.

Castletown.

CASTLETOWN is the most southerly, and the first in order of the harbours described in Sir John Rennie's report of 1838. In that report he recommends the pier to be extended from 25 to 30 yards in its present direction, and then 50 yards in an E.S.E. direction, and that the rocks should be excavated, 100 yards wide, down to the level of low water. These works are estimated at 4,500*l.* The proposed addition to the pier is shown, coloured *red*, on the accompanying plan.

The report of 1836 recommends 500*l.* or 1000*l.* to be expended for the purpose of giving a little more shelter to the smaller class of fishing boats. The *blue*, upon the accompanying plan, shows what is intended by this minor proposal.

Castletown is, I believe, the oldest harbour in the island. It is decidedly the worst I have seen; and from its exposure to the prevalent winds, being open from south to south-west, with a dangerous rocky bottom and shore in front, and an entrance seven to eight feet above low water, is in my opinion incapable of being made a good harbour. These natural defences against approach of an enemy may have rendered the situation an eligible one for the castle, but obviously unfitted it for the purposes of a good harbour.

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On the other hand, the town contains a population of 2,500; and in a memorial from the inhabitants to the commissioners, in 1834, it is stated that considerable quantities of coals are brought into it, that much agricultural produce is shipped there, that the imports and exports have increased, and that the want of improvement is so felt that the inhabitants would subscribe liberally. For the local trade, therefore, which, with the dues, would increase if the harbour were improved, I think something should be done, but that, previous to determining how much, it may be desirable to know to what extent, and in what way the inhabitants would contribute. In recommending this course, I may at first sight appear to go beyond the letter of my instructions; in explanation of which I would state, what will indeed be evident on reference to the accompanying plan, that if the smaller design were executed first, it would so interfere with the more considerable improvements, that the former would have to be taken down or removed preparatory to the execution of the latter. The smaller plan proposes leaving at once the line of the present pier, and adding a length of 30 yards (so far as I can ascertain by the scale) in a direction three points east of the present line, in order to bring the head within the protection of the Skerane's Point; while the more enlarged design proposes an extension in the direction of the present pier for 25 to 30 yards in length before making an angle, and thence a further length of 50 yards at nearly the same angle as before stated. In this case, therefore, it will be expedient to have the final plan definitely fixed upon before anything is begun. This determined, I think Sir John Rennie's plan in either case will be some improvement; although even then it will be impossible, in my opinion, for vessels to remain below the bridge during the prevalence of heavy winds between the south and west, without great risk of damage by striking upon the rocky bottom, while taking or leaving the ground. If the improvements be made with the expectation of obviating this inconvenience, there is at least reason to fear that there will be disappointment as respects the estimate. It is of course only with the smaller plan that I have at present to deal; and taking Sir John Rennie's estimate of the 30 yards as 1000*l.*, it considerably exceeds the calculation according to the prices given to me while on the island, and confirmed by the estimate of Mr. Carr, builder, since transmitted to me. My own dimensions and prices produce a larger amount by several hundred pounds; but for the present purpose, 1000*l.* may be assumed as in round numbers the fair estimate for this small improvement.

I quite concur in the opinion, that Castletown harbour offers but little temptation to expend much money upon it.

DERBY HAVEN, the next in order, is justly described as the proper and safe port even for Castletown, and used as such, goods being carted from Derby Haven to Castletown.

In his report of 1838, Sir John Rennie considers it under two points of view; viz., as an asylum harbour for shipping in general, or as confined to the protection and accommodation of the numerous fishing and small boats which frequent it. For its improvement in this latter respect only, he proposes a present expenditure, which is stated at 5000*l.* in the report of 1836, being for a portion only of the eastern break-water, that is, nearest the land in shallow water. In the report of 1838, the erection of both break-waters and a pier or jetty is estimated at 17,600*l.*

Derby Haven is rightly considered the best harbour on this side of the island, whether for the shelter of small vessels, or the fishing boats which resort to it in great numbers. The anchorage in the bay is good, and the shelving sandy shore favourable for grounding. Fort Island affords an excellent protection from the the prevailing winds; and against all winds except from south-east to east it may be said to be secure, but to these it is very open, and serious damage is sometimes done by them.

In a memorial to the commissioners by the inhabitants of Castletown and Derby Haven, dated October, 1836, distressing casualties are stated to have occurred. One is particularized as having taken place on the 12th of that month, which drove on shore and broke to pieces a large schooner and five fishing vessels. To prevent further calamities, they propose that a sea wall should be built on the rocks bounding the east side of the harbour; agreeing, therefore, with Sir John Rennie's recommendation. Had the natural protections of Derby Haven been less than they are, it is probable that this sea wall or break-water would have long ago been done; the material is at hand in the rocks which lie upon the east side of the haven, and they themselves form a natural break-water until nearly half-flood. My opinion, therefore, is that the proposed break-water will be very useful; and as any portion that may be done for 5000*l.* will form a part of the more enlarged extension, this smaller expenditure cannot interfere with the execution of the ultimate improvements, of which every part will be serviceable. I would recommend the building to commence from the conical beacon, that has lately been erected, to form the east pier of the entrance, and work inwards towards the land, which I apprehend would be found to have the most useful effect (see the accompanying plan). The portion that Sir John Rennie proposes to do for 5000*l.* begins at the land opposite Ronaldsway, and goes outwards (as shown by his plan) nearly 300 yards, where protection appears to be less important.

I have not a section of the ground nor of the proposed break-water, by which to calculate quantities; but, considering the great facility of procuring materials, and supposing the average height to be 12 feet, my opinion is that 5000*l.* will accomplish an useful purpose. Even in case of the outer works being eventually done to render this an asylum harbour, what is now proposed for immediate execution will not stand in the way, but will continue to be advantageous to the general trade of that part of the island, including Castletown, with which, as Sir John Rennie observes, Derby Haven may be connected by a railway. Mr Quirk, the commissioner nominated by the Treasury, informs me that 250 boats, measuring about 7000 tons, and employing 2500 men, besides a numerous fleet of Irish and Cornish boats, are occupied in the herring fishery alone. These are exclusive of many that are employed as carriers for the English and Irish markets, and in the grey fishery, all of which, with numerous coasters, would occasionally derive benefit from the proposed break-water, both in trade and for shelter. In short, there is strong reason for no longer delaying this most useful work.

Douglas.

DOUGLAS, the next in order, contains a population of 8000, or one-fifth of that of the whole island, and 50 per cent more than Ramsey, Castletown, and Derby Haven united. It is the only port at which goods imported by licence are allowed to be landed, and therefore the chief establishment of the customs department. It is also a post office packet station; the principal resort as a watering place; the port used by the Liverpool steamers; situated near the centre, and virtually the capital of the island as respects business and fashion, with its fine bay in front of the town. In the consideration, therefore, of the different harbours, Douglas has naturally been entitled to and has received the principal attention, in regard to its protection and improvement; the erection of the north pier alone having cost 26,000*l.*

Sir John Rennie's report of 1835, on this harbour exclusively, has reference to works that were

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intended chiefly with a view to an asylum harbour. He therein proposes running out a break-water pier, 340 feet long, from Two-gun Battery on the south side of the harbour; a similar pier, 400 feet long, from St. Mary's Isle (a small islet lying north-east of the pier head); and a detached break-water, 1400 feet long, between these; all of which he estimates at 215,652*l*., and to give an area of 45 acres, which he considers sufficient for 200 vessels of the largest class of merchantmen and king's ships.

The report of 1836 recommends 7000*l*. to be appropriated to this harbour; and the small scale drawing attached to the reports shows the additions which it was proposed to effect, according to what are afterwards described.

The last report of March, 1838, states the exposure of the harbour to easterly gales; that to remedy this evil he had recommended a small work to be constructed below St. Ann's Fort, which, he doubts not, will have the desired effect, so far as it goes; but that, in order to make the entrance complete, other works will be required, which are estimated at 6,800*l*.

I was at a loss to discover, with precision, what these last improvements were, until I referred to a written copy of the report of 1835, which I had received in October last from the Commissioners. I find it there recommended, in order to make the present harbour safe for the existing and increasing trade as a tide harbour, that the present pier be extended about 200 feet, and to run out a small work or pier near St. Ann's Fort, opposite to the new pier head, leaving an opening of 150 feet clear between them; and to construct on it a jetty near the present pier head, with a corresponding jetty on the opposite short pier above-mentioned, leaving a clear width of 100 feet between them for an entrance. These works would, Sir John states, effectually check the in-run of the sea, and give two feet more water at the entrance; that they would, moreover, serve to give the current a better direction, and increase the scour at the entrance, both upon the flood and ebb.

A tracing of a plan to a large scale, dated 2nd April, 1835, and signed by Sir John, shows both the inner piers, and two designs for outer break-water piers for an asylum harbour; but neither of these corresponds with his report of 1835, which recommends a detached break-water, with two entrances, in place of break-waters run out from the shore with one entrance between them.

Of the above, the small work or pier near St. Ann's Fort is the only part which has been executed (see accompanying plan). It was built last year at an expense of 2,900*l*.; and is stated by Mr. Moore to have fully answered the expectations of a great portion of the public and of the Commissioners. Other statements made to me speak of its effects less favourably. I apprehend that the upper part of the harbour must have been quieted, and that vessels now lie in the lower part of the harbour with less motion and liability to damage than before; but the effects of easterly storms upon the entrance and the north pier must rather have been increased than otherwise, unless when the vessel has a good deal of way upon her.

If the intention be to apply the 7000*l*., or a considerable portion of it, in adding to the length of the north pier, as proposed by Sir John Rennie, I must say that I do not expect corresponding benefit from it; and that I think narrowing the entrance to 28 yards, the width upon his sketch, by jetties directly opposed to the waves, will by the rebound from them still further increase the difficulty of entering during heavy gales, so that I cannot recommend that plan to be adopted. My opinion also is that, although the execution of this smaller work would offer no physical obstruction to any further and more considerable improvements, yet if any extensive works should ultimately be resolved on for the protection of the outer harbour, the minor additions to the present piers may in a great measure be rendered useless. Before sanctioning the expenditure of more money on such partial improvements, therefore, it would be advisable to fix upon the more important plan. It may be such possibly as to admit of being carried into effect by degrees, as the funds can be obtained; the benefit derived from it being progressive also.

Considering the importance of Douglas harbour to the island and to the shipping generally, which Sir John Rennie has stated very fully in his report of 1835, I think the subject of its improvement highly deserving of attention.

As respects cost, I am of opinion that 7000*l*. will not be found sufficient to erect the piers and jetties, according to the plans of June, 1836.

Ramsey.

RAMSEY is the last harbour in the list referred to me, for which, in his report of 1836, Sir John Rennie recommends an appropriation of 5000*l*. to be expended in running out a pier, 150 yards long, in a north-east direction from the point where the line of high water falls upon the present south pier.

The more extensive report of 1838 states Sir John's coincidence in the opinion of the late Mr. Rennie, who, in his report of 1814, "recommended that a pier should be constructed on the south side, and continued in a north-east by east direction towards low water mark; and that another smaller pier on the north side, aided by several small low water jetties, should be carried out from the north shore at right angles to the south pier or parallel to it, having a space between it and their extremities of about 150 feet wide, between the extremities of the piers, and increasing from thence to low water, to about 200 feet, more or less, as may be requisite."* The object of these works was to confine the course of the river to one direction, and to prevent its being obstructed by the sand. Sir John proposes confining this, in the first instance, to low water of neap tides, which he estimates at 19,500*l*.; but adds, that even half that sum expended upon the same principle would be beneficial.

In his report of 1838, Sir John Rennie also refers to another report, where he has recommended works upon a more extensive scale, to give accommodation to vessels at low water. This report I have not seen.

The direction of the smaller pier, proposed in 1836, is about 15 degrees (one and a quarter point) more to the northward than in the more detailed design of 1838; but I apprehend that the direction of the latter was considered an improvement upon that of 1836, and that the work of a south pier, to however small an extent, might be made to form a portion of the larger design when effected. If so, the former would not interfere with the further and more considerable improvement of the harbour, recommended by the report of 1838; particularly as the direction, though not the situation, of the smaller work of 1836 appears to agree nearly with that proposed by the late Mr. Rennie in 1814, with which, as I have already stated, Sir John's opinion coincides. This plan of 1814 is much more extensive than either of Sir John's plans. It proposes two parallel piers, 130 feet apart, carried down to low water in a north-east by east direction, the confining and straightening of the river opposite the town by numerous jetties, and a wet dock above the town. From the expense of such a work, I presume that it is at present entirely out of the question, were it otherwise expedient, and if made under the expectation of giving accommodation to vessels as an asylum near the time of low water, I think it would not answer the purpose.

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* This description of Sir John's appears to me to apply more to his own design of 1838 than that of Mr. Rennie's of 1814, as will appear by the description of the latter at p. 16, extracted from Mr. Rennie's report of 1814.

Appendix B.

Isle of Man

No. 154.

Walker, on the Improvement of the Harbours.

Ramsey bay is a very important station, from its position in the direct line between the Firth of Clyde and Liverpool; from its good anchorage; from its being protected from all westerly winds by the land, and partially even from easterly winds by the Bahama Bank. A better protection from north-easterly storms is what is wanted. That the bay in its present state is not very unsafe, is proved by the fact that, notwithstanding the many vessels which anchor here, only two wrecks had taken place during the seven years preceding my visit; and one of these (the St. Peter, of Borgs) through the ship fouling her anchor; the other, a vessel of 40 tons, was lost with all hands a mile north of the harbour.

It is to be remarked, that when the late Mr. Rennie surveyed Ramsey in 1814, the point of discharge of the river into the sea was considerably south of the present, as shown by the accompanying plan; and one of his objects in proposing the south pier appears to have been to divert and confine the channel into a straight and more northerly direction. The sands and currents have since caused considerable alteration; the plan shows the directions of the outfall of the river in 1836, and 1838, by Sir John Rennie, and in the autumn of 1838, when I surveyed it.

Another object of the projected south pier was, by extending it in a north-east by east direction to form with the point of Ayr a protection against easterly winds, and also to make the current of discharge from the harbour to fall into the direction of the ebbing tide. I think these objects would be accomplished by the south pier, if carried out in the more northerly direction; and which would, at the same time, tend to reduce the chief objection that appears to the late Mr. Rennie's extended parallel piers, viz., the difficulty of getting out of the harbour with east winds, when a heavy sea rolls in between the piers, and of working in with westerly winds. The erection of a pier of sufficient strength down to low water would, however, be a work of heavy expense; and I do not think that much good would be effected by the partial work proposed by the plan of 1836, which (with a view to economy, I presume) is different in position from the plan of the late Mr. Rennie, made in 1814, as well as from that shown in the plan of 1838 by Sir John Rennie.

As the movement of the sand to the north or south is influenced more by the wind being in the one or other direction than by any other cause, a south pier not carried down to low water, though it will prevent the accumulation of sand from the southward, will have a contrary and therefore an injurious tendency when the wind is from the northward, by causing the sand to collect inside the pier and in front of the entrance. To prevent this, a north pier is of more importance, and hence purely the good effect that has resulted from the small north pier, which was erected a few years since at an expense of some 600*l.* or 700*l.* Previous to this being built, the land water, so soon as it got round the inner or west angle of the south pier, was carried to the northward by the ebbing tide, so as to have no fixed line of direction, and vessels entering with easterly winds were in great danger of being thrown upon the west slope; in addition to which, the flood-tide and northerly winds, threw the sand into and choked the passage. The north pier, so far as it goes, prevents the latter evil, and a permanently eastern direction, to the extent of the pier, is given to the current outwards. The result has been to render the entrance more easy, to widen and shelter the harbour itself, particularly the lower end of it, and to add three or four feet to the available depth.

A petition from the inhabitants to the Commissioners stated that, since the north pier was built, the harbour dues have quadrupled in amount; and that a further extension of that pier for 120 yards, its present length being 80 yards, would give an additional depth of water, and would be of essential service in saving property and lives.

My opinion, formed upon the grounds I have stated, is that an extension of the north pier would be a decided improvement, and that this would be the most beneficial application of money in the first instance. Sir John Rennie's opinion being favourable to the erection and extension of a north pier, I do not feel that I am trespassing beyond the line of my instructions, in recommending that this be the portion of the plan first proceeded with; and that the addition be made to the end of the present north pier in such direction as may be recommended, in place of building an entirely new north pier.

The recommendations of the foregoing Report may be briefly stated thus :—

Castletown.—To delay for the present the extension of the pier, until the intentions of the inhabitants, as expressed in their petition, are explained.

Derby haven.—To execute without delay the southern portion of the north break-water, designed by Sir John Rennie.

Douglas.—Not to proceed with the execution of the minor works recommended by Sir John Rennie; and that previous to any small work being done, the more general plan for improving the harbour be considered, and, if possible, be determined on.

Ramsey.—That the first improvement be the extension of the north pier.

To F. S. Baring Esqr., M.P.,
&c. &c.

I am, &c.,
James Walker.

No. 155.

No. 155.

Timperley, on the state of the Harbours.

Report of J. Timperley, Esq., Resident Engineer, *on the present state of the Harbours in the Isle of Man.*

Gentlemen, *Castletown, Isle of Man*, 28*th February*, 1845.

Having received your directions to furnish you with "copies of all maps of the Ports or Harbours in the Isle of Man, and also of the defects (or requisite improvements) of the said Harbours," in order that you might transmit the same, along with other particulars, to Sir James Graham, one of her Majesty's principal Secretaries of State, agreeably to an order of the first inst. I, therefore, herewith return you eight maps of the principal harbours, showing their present state; the works recently executed are coloured green, the proposed works, or future improvements, being coloured red.

The works recently executed are the breakwater at Derby Haven, and the extension of the north pier at Ramsey, which were proposed by Sir John Rennie and approved of, with some modifications and improvements by Mr. Walker, and upon which an order was given by the Lords Commissioners of her Majesty's Treasury bearing date 16th October, 1839, to carry the said works into effect.

After obtaining a loan of 6000*l.* by two equal instalments from the Exchequer Loan Commissioners for this purpose, these works were commenced in the early part of the year 1842, and both completed before the end of the year 1843. Derby haven breakwater, which is 260 yards long and 26 feet wide at the top, cost 3506*l.* 18*s.* 3*d.*, and the north pier at Ramsey, which is 123 yards long by 25 feet wide at the top, on average cost 2,520*l.* 7*s.* 3*d.*, or together 6,027*l.* 5*s.* 6*d.* See Plans No. 1 and 2.

APPENDIX B.

ISLE OF MAN.

No. 155.

Timperley, on the state of the Harbours.

In addition to the above works, and pursuant to the recommendations of the aforesaid engineers, that some improvement was required to the harbour of Castletown, a new pier has been in part executed during the present year by the Harbour Commissioners with their own funds, of 384 feet in length by 30 feet wide at the top (including the parapet wall), the cost of which is 1946*l.* 4*s.* 2*d* this when extended as far as is shown in the Plan No 3, or perhaps not quite so far, will be a complete protection to the present harbour, and also form a commodious basin for business of about one acre and a quarter, contiguous to the present harbour. It may be proper to state that the whole of the aforegoing works have been substantially and durably executed, and have completely answered the purpose for which they were intended.

As respects the further improvement of the harbours, that of the port of Douglas is justly considered the most essential; two plans have been proposed by Sir John Rennie; one of these was merely to protect the present harbour, by some additions to the present piers; the other was to form a deep water asylum harbour for vessels to run to in all states of the tide Mr. Walker at the conclusion of his report of May, 1839, states, "as respects Douglas, not to proceed with the execution of the minor work recommended by Sir John Rennie, and that previous to any small work being done the more general plan for improving the harbour be considered, and if possible determined upon;" which is also in accordance with the orders of the Lord's Commissioners of her Majesty's treasury of the date above mentioned.

The Commissioners of these harbours aware of the great importance of a deep asylum harbour in Douglas Bay, would strongly recommend a part at least of Sir John Rennie's plan to be carried into execution viz., a breakwater of about 200 yards in length from the point at the two gun battery marked on the Plan' No. 4, with a road from thence to the town, the cost of which is estimated at 18,068*l.*, this would effectually tranquilize the present harbour, and afford shelter at all times to vessels in distress, the depth being from five to six fathoms at low water, but as the cost would greatly exceed the means of the Harbour Commissioners, it cannot be done without the assistance of her Majesty's government.

For the security of fishing and other small vessels on the south west coast, a small harbour for shelter in the bay of Port Erin, particularly in the herring season is very desirable, and has long been wanted; this work is proposed to be about 100 yards in length, and to cost about 2,000*l.*; this would enable vessels at once to proceed to the fishing station in this district after gales of wind, which are now prevented when taking refuge in the harbours of Peel and Port St. Mary.

This bay is generally considered as peculiarly well formed for a harbour of refuge, other sites have been mentioned more to the north, as being more central; but there can be no doubt that an asylum harbour accessible at all states of the tide would be of the greatest advantage, and be the means of preventing the loss of life and property upon this part of the coast, a most melancholy instance of which happened only a few weeks ago (see Plan No. 5).

A landing pier at Laxey has been already proposed by Sir John Rennie, which was considered so desirable by the owners or workers of the Laxey mines, and other part iesinterested, that a sum of money was actually subscribed, in order to assist in carrying this work into effect; a pier of 150 yards in length is considered amply sufficient, and which might be executed for about 2,000*l.*, (see Plan No. 6).

The several reports and communications relative to these harbours which you sent for my inspection, I have returned with this report.

I am, Gentlemen,
Your most obedient, and humble servant,
JOHN TIMPERLEY.

To the Commissioners of Harbours,
Isle of Man.

No. 156.

Number of Boats employed in the year ended 5th Jan., 1846, in the Herring and Cod and Ling Fisheries, &c.

No. 156.

ISLE OF MAN FISHERIES.

An ACCOUNT of the NUMBER of BOATS belonging to the ISLE of MAN that have been employed in the Year ended 5th January, 1846, in the Herring and Cod and Ling Fisheries, the Tonnage, Number of Men, and the probable Value of the Boats, Nets, and Lines.

DIVISION.	Number of Boats.	Tonnage.	Number of Men and Boys.	Value of Boats.	Value of Nets.	Value of Lines.	Total Value.
				£.	£.	£.	£.
Douglas . . .	116	500	655	4,750	1,800	90	6,640
Castletown . .	184	1,751	1,187	29,405	6,408	300	36,113
Peel	200	2,404	1,336	25,240	8,064	180	33,484
Ramsey . . .	106	490	635	4,550	2,520	120	7,190
Grand Total . .	606	5,145	3,813	63,945	18,792	690	83,427

N.B. Of the above 606 Boats, there are 278 yawls that follow the inshore fishing, the tonnage and value of which have not been ascertained.

I do hereby certify that the above account is correct, according to the best of my knowledge and belief, insofar as the same could be ascertained.

JAMES MACKENZIE,
Officer of the Fishery.

Office for the Herring Fishery,
Douglas, 18*th February,* 1846.

P.S. There are, on an average, from 45 to 50 Irish smacks, manned with from six to eight men each, and from 40 to 45 English and Welsh vessels, manned with from three to four men each, all employed in running fresh and bulk fish to Liverpool and other ports in the English Channel, &c. There are also, on an average, 200 Irish fishing-boats, manned with six men each, and about 200 English boats (more or less, according to the state of the fishing), manned with six men each. All are employed on the coast of the Isle of Man during the fishing season, and consequently frequenting its harbours.

APPENDIX B.

ISLE OF MAN.

No. 157.
List of Wrecks on the Coast, 1822-45.

LIST OF WRECKS on the COAST of the ISLE OF MAN, 1822–45.

DOUGLAS BAY AND ITS NEIGHBOURHOOD.

Date.	Name of Vessel.	Rig.	Belonging to.	No. of Lives lost.	Wind.		Estimated loss on Vessels and Cargoes.	Remarks.
					Force.	Direction.	£.	
1822	Vigilant	H.M.Cutter	..	..	Strong breezes	S S E.	1,500	Stranded, but got off.
1825	City of Glasgow	Steamer	Glasgow	..	,,	E.S.E.	5,000	Stranded, but got off.
,,	Margaret	Sloop	Leith	4	,,	S E.	1,500	Total wreck at Port Sodrick.
1826	Fancy	Sloop	Liverpool	..	,,	S.E.	1,200	Total wreck.
1827	Fortroindet	Barque	Carlskrona	..	,,	S.W.	8,000	In entering Douglas Harbour, her halser gave way, and she was totally wrecked upon a rock called Connister.
1828	Ann and Margaret	Smack	Dundalk	..	,,	S.E.	500	Sprung a leak at sea, bore up for Douglas, and run her on shore at low water, but she afterwards got off.
,,	Hollow Oak	Brig	Whitehaven	..	,,	S.S.E.	100	The same.
1830	St. George	Steamer	Liverpool	..	,,	S.S.E.	10,000	Drove from her anchors, and totally wrecked on Connister.
,,	Eclipse	Smack	Glasgow	..	,,	E.S.E.	3,000	Total wreck.
,,	Dolphin *or* Baltic	Brig	Whitehaven	10	,,	E.S.E.	2,000	Total wreck off Kirk Santon Head.
1832	Swift	Sloop	Port Elley	3	,,	S.E.	800	Foundered close in with Douglas.
1833	Sarah	Brig	Whitehaven	6	,,	S.E.	1,500	Total wreck near Douglas Head.
,,	St. Patrick	Smack	Douglas	..	Moderate	E.	170	Total wreck at Clay Head.
,,	Aurora	Schooner	London	..	Strong breezes	E.S.E.	500	Stranded, but got off.
,,	James Wilson	Schooner	Douglas	..	,,	N.E.	200	Total wreck in Laxey Bay.
,,	Mary	Schooner	Newry	..	,,	N.E.	200	Stranded, but got off.
1834	Arab	Snow	Liverpool	..	,,	S.W.	550	Stranded, but got off.
,,	Parkfield	Ship	Liverpool	..	,,	S.S.E.	5,000	Stranded, and was much damaged, but afterwards got off.
1835	King George 4th	Brigatine	Belfast	..	Moderate	N.E.	700	Total wreck near Douglas Pier Head.
,,	Name unknown	Smack	Whitehaven	..	Strong breezes	S.E.	70	Total wreck.
,,	Elizabeth	Brig	Greenock	..	,,	S.E.	3,000	Total wreck off Kirk Santon Head.
1836	Sarah	Brig	Whitehaven	..	,,	S.E.	50	Stranded, but got off.}
1837	Vernon	Schooner	Glasgow	..	,,	N.E.	900	Stranded in Laxey Bay, but got off.
1838	Jule	Galliot	Brugge	10	,,	S.E.	1,500	Total wreck at Port Sodrick.
,,	Brilliant	Brig	Newcastle	4	,,	S.E.	2,000	Total wreck near Kirk Santon Head.
,,	Shepherd	Schooner	Liverpool	..	Strong breezes	S.E.	560	Stranded, but got off.
1839	Friends Goodwill	Trawl-boat	Liverpool	1	,,	S.E.	250	Total wreck in Laxey Bay.
,,	Nancy	Sloop	Inverness	..	,,	S.E.	170	Total wreck.
1840	Ellen and Nelly	Smack	Douglas	..	Moderate	S.E.	180	Total wreck.
,,	John Dorey	Trawl-boat	Liverpool	..	Strong breezes	S.E.	900	Total wreck.
,,	Batty and Jenny	Smack	Harrington	..	,,	E.	170	Total wreck.
,,	Unity	Galliot	Maryport	..	,,	S.E.	300	Total wreck, drove on shore from her anchors.
1841	New Volunteer	Smack	Douglas	..	,,	S.E.	170	Upon entering Douglas Harbour, was totally wrecked on the south side under fort Anne.
,,	Caledonia	Smack	Ramsey	..	,,	N.W.	250	Foundered close in with Douglas Head.
1842	George	Smack	Port-a-ferry	..	,,	S E.	85	Stranded, but got off.
,,	Mary and Joseph	Schooner	Castletown	..	Moderate	E.	100	Stranded, but got off.
,,	Kitty and Peggy	Lugger	Port St. Mary	..	,,	N.W.	40	Run down by a steamer in Douglas Bay.
1845	Providence	Smack	Douglas	..	,,	S.W.	100	Total wreck on Banks's How.

DERBY HAVEN AND ITS NEIGHBOURHOOD.

Date.	Name of Vessel.	Rig.	Belonging to.	No. of Lives lost.	Wind.		Estimated loss on Vessels and Cargoes.	Remarks.
					Force.	Direction.		
1822	St. Lawrence	Brig	Montreal	..	Moderate	W.	200	Put into port to repair damage sustained at sea.
1824	Lord Nelson	Brig	Milford	..	Strong breezes	N W.	150	Stranded, but got off.
,,	Otter	Sloop	Liverpool	..	Moderate	S.E.	50	Stranded, but got off.
1828	Solid	Brig	Dram	..	Strong breezes	E.S.E.	100	Stranded, but got off.
1828	Earl of Roden	Steamer	Dundalk	..	,,	S.E. by E.	5,000	Drove from her anchors, and was stranded, but got off much damaged.
1830	Ann	Sloop	Cardigan	..	,,	S.E.	200	Stranded, but got off.
,,	William & Mary	Schooner	Youghal	..	,,	E.S.E.	170	Stranded, but got off.
1833	Laurel	Sloop	Newry	..	,,	N.W.	50	Mast cut away, to prevent her from driving upon a lee shore (Fort Island).

LIST OF WRECKS on the COAST of the ISLE OF MAN, 1822–45.—*Continued.*

No. 157.
List of Wrecks on the Coast, 1822-45.

Date.	Name of Vessel.	Rig.	Belonging to.	No. of Lives lost.	Wind.		Estimated loss on Vessels and Cargoes.	Remarks.
					Force.	Direction		
DERBY HAVEN.—*Continued.*								
1835	Rovina	Schooner	Beaumaris	..	Strong breezes	E.S.E.	£. 1,200	Total wreck.
,,	Rulland Castle	Schooner	Balbriggan	..	,,	S.E.	500	Stranded, but got off.
1836	Mary	Schooner	Kincardine	..	,,	E.S.E.	2,000	Total wreck.
1839	Minerva	Brig	Whitehaven	..	Moderate	S.W.	1,200	Total wreck.
,,	Pursuit	Schooner	Lerwick	..	Strong breezes	S.E.	350	Stranded, but got off.
1840	Unicorn	Schooner	Chester	..	,,	S.W.	88	Cut away the foremast, to prevent her from further driving from her anchors upon a lee-shore.
,,	British Heroine	Ship	Glasgow	..	,,	S.E.	3,000	Total wreck; driven on shore from her anchors.
1841	Dasher	Smack	Derbyhaven	..	,,	SE. by E.	170	Total wreck.
,,	Lavinia	Schooner	Falmouth	..	,,	S.E.	700	Stranded, but got off.
1844	Majestic	Brig	Kincardine	..	,,	S.E.	150	Driven from her anchors; stranded, but got off.
CASTLETOWN AND ITS NEIGHBOURHOOD.								
1822	Maria	Brig	Dublin	11	Strong breezes	S.S.W.	4,000	Total wreck on Scarlet.
1824	Reynolds	Brig	Liverpool	11	,,	S.W.	3,500	Foundered and sunk.
1826	Deborah	Brig	Whitehaven	..	,,	S.W.	200	Stranded, but got off.
1827	Atalanta	Brig	Liverpool	1	,,	S.W.	3,000	Total wreck.
1829	Eleanor	Brig	Liverpool	..	Moderate	S.W.	3,500	Total wreck.
,,	Sportsman	Brig	Ayr	..	Strong breezes	S.W.	3,000	Total wreck near Pool Vaish Bay.
1831	Swift	Smack	Liverpool	..	,,	S.W.	250	Total wreck.
,,	Mary Ann	Sloop	Cardigan	..	,,	W.	500	Stranded, but got off.
1834	John Fairdeld	Brig	Liverpool	..	,,	S.W.	40,000	Total wreck near Scarlet.
1835	Ann	Schooner	..	..	,,	S.W.	2,500	Total wreck in Pool Vaish Bay.
1836	Betsey	Brig	Newry	..	,,	S.W.	500	Total wreck.
,,	Cadiz	Schooner	Glasgow	..	,,	S.W.	800	Stranded, but got off.
1838	Industry	Brig	Whitehaven	5	,,	S.W.	1,200	Total wreck.
1843	Flora	Brig	Whitehaven	..	,,	S.W.	1,200	Total wreck near Scarlet Head.
1844	Success	Smack	Arklow	..	,,	S.W.	100	Total wreck.
LANGNESS.								
1822	Racehorse	H.M Sloop	———	7	Moderate	S.S.W.	18,000	Total wreck.
1823	Robert	Brig	Whitehaven	43	Strong breezes	S.W.	2,000	Total Wreck.
1824	Robert	Brig	Harrington	..	Moderate	S.W.	2,000	A dense fog. Total wreck.
1835	Active	Brig	Whitehaven	..	Strong breezes	S.E.	1,200	Total wreck.
,,	Bee	Barque	Glasgow	..	,,	S.E.	1,300	Stranded, but got off.
1837	William M'Leary	Schooner	Wick	..	,,	S.E.	500	Total wreck.
1840	Mary Ann	Schooner	Donaghadee	..	,,	S.E.	800	Total wreck.
1845	Speculation	Smack	Castletown	..	Moderate	S.W.	250	Total wreck.
1846	Larch	Brig	Whitehaven	..	,,	S.W.	600	Brig of 182 tons. Total wreck. From Dublin to Whitehaven.
PORT ST. MARY.								
1822	Jennies	Sloop	Glasgow	..	Strong breezes	S.E.	500	Stranded, but got off.
1823	Express	Sloop	Liverpool	..	,,	S.W.	150	Stranded, but got off.
1826	New Liberty	Schooner	Stranraer	..	,,	N.W.	100	Sprung a leak at sea. Put in to repair.
1827	Ann Brunet	Sloop	Donaghadee	..	,,	S.S.W.	1,000	Total wreck.
1830	Margaret	Sloop	Rothsay	..	,,	S. by E.	1,000	Total wreck.
1838	Kingston	Barque	Liverpool	..	Moderate	S.W.	500	A dense fog; stranded near Port St. Mary Bay, but got off.
1840	St. Andrew	Schooner	Kirkcudbright	..	Strong breezes	S.W.	176	Stranded, but got off.
,,	Betty and Jenny	Smack	Port St. Mary	..	Moderate	N.W	50	Stranded, but got off.
1842	Sarah	Schooner	Port St. Mary.	..	,,	S.E.	170	Stranded, but got off.
,,	Amelia	Smack	Newry	..	,,	S.W.	300	Total wreck on Spanish Head.
,,	Rushen Castle	Smack	Port St. Mary	..	Strong breezes	S.E.	100	Stranded, but got off.
CALF OF MAN.								
1823	Emelia	Smack	Port St. Mary	8	Strong breezes	S.W.	450	Supposed to have foundered close in with the Calf of Man.
1824	Peel Castle	Smack	Peel	9	,,	S.W.	450	Supposed to have been wrecked on the Calf of Man.

APPENDIX B.

ISLE OF MAN.

No. 157.
List of Wrecks on the Coast, 1822-45.

LIST OF WRECKS on the COAST of the ISLE OF MAN, 1822–45.—*Continued.*

Date.	Name of Vessel.	Rig.	Belonging to.	No. of Lives lost.	Wind.		Estimated loss on Vessels and Cargoes.	Remarks.
					Force.	Direction.		
				CALF OF MAN.—*Continued.*				
							£	
1827	Lion . . .	Brig	Workington .	..	Strong breezes	N.E.	1,300	Foundered close in with the Calf of Man.
1828	George . . .	Schooner	Derby Haven .	..	Moderate	N.E.	250	Stranded and sunk in the sound of the Calf.
1839	Victoria . . .	Lugger	Peel	..	Strong breezes	N.W.	50	Stranded, but afterwards got off.
1840	Amelia Sophia .	Schooner	Yarmouth . .	..	,,	S.W.	3,000	Foundered close in with the Calf of Man.
1841	Asp	H. M. Steamer	..	..	Moderate	S.E.	200	Dense fog, stranded, but afterwards got off.
1843	Mary Ann . .	Smack	Douglas . .	..	,,	S.W.	100	Total wreck on Kitterland Island.
				PORT ERIN.				
1843	Sovereign . .	Schooner	Carrickfergus .	..	Moderate	S.S.W.	80	Stranded, but got off.
1845	Wilhelmina. .	Schooner	Glasgow . .	8	Violent	N.W.	12,000	Total wreck.
				PEEL.				
1822	Industry . .	Brig	Port-a-ferry . .	..	Strong breezes	N.W.	200	Stranded, but afterwards got off.
1823	Lively . . .	Galliot	Preston . . .	..	,,	N.W.	200	Stranded, but afterwards got off.
1824	Blucher . . .	Smack	Belfast . . .	..	,,	N.W.	500	Sustained damage in entering the harbour.
,,	Julia . . .	Schooner	Liverpool . .	..	,,	S.W.byS.	150	Sustained damage at sea and entering the harbour.
1827	Carry-on . .	Smack	Peel	2	,,	S.W.	100	Foundered near Contrary Head.
1828	Brisk . . .	Brig	Whitehaven . .	1	,,	N.W.	3,600	Total wreck, near Kirk Michael.
1833	Java . . .	Smack	Glasgow. . .	..	,,	N.W.	200	Stranded, but afterwards got off.
1834	Sarah . . .	Brig	Tralee Limerick.	..	,,	N.W.	4,000	Total wreck near Kirk Michael.
1835	Juno . . .	Smack	Belfast . . .	1	,,	N.W.	2,000	Total wreck.
,,	Violet . . .	Brig	Leith . . .	..	,,	N.W.	150	Stranded, but afterwards got off.
1843	Etty and Peggy	Smack	Peel	..	,,	N.W.	120	Drove on shore from her anchors and was totally wrecked.
1845	Dundee . . .	Schooner	Dundee . . .	..	,,	N.W.byW.	5,100	Total wreck near Kirk Michael.
				JURBY HEAD.				
1828	Shamrock . .	Schooner	Liverpool . .	..	,,	N.W.	300	Stranded, but got off
1831	Fanny and Maria	Smack	Peel	..	,,	E.N.E.	170	Total wreck.
1833	Orwell . . .	Ship	Hull	..	,,	N.E.	5,000	Total wreck.
				AYR POINT.				
1833	Brilliant . .	Sloop	Glasgow . .	..	,,	N.E.	2,500	Total wreck.
1836	Willam . . .	Brig	Milford . . .	..	,,	N.E.	2,000	Total wreck.
1840	Triton . . .	Trawl-boat	Whitehaven .	2	,,	N.E.	280	Total wreck.
1845	Esther and Jana	Smack	Stranraer . .	..	,,	N.E.	800	Foundered close in with the point of Ayr.
				RAMSEY AND ITS NEIGHBOURHOOD.				
1831	Arrow . . .	Smack	Preston . . .	3	,,	E.	500	Total wreck on Maughold Head.
,,	Union . . .	Sloop	Barmouth . .	..	,,	E.S.E.	700	Total wreck.
1832	Defiance . .	Smack	Ramsey . . .	..	,,	N.E.	500	Stranded, but got off.
1834	St. Peter . .	Ship	Bonga . . .	8	,,	N.E.	5,000	Total wreck.
,,	Glenlyon . .	Smack	Ramsey . . .	..	,,	N.E.	410	Total wreck.
,,	Emulous . .	Smack	Ramsey . . .	5	,,	N.E.	150	Total wreck.
,,	Adventure . .	Brig	Whitehaven . .	..	,,	N.E.	250	Stranded, but got off.
,,	Hectorina . .	Sloop	Dromore . .	..	,,	E N.E.	200	Stranded, but got off.
,,	Sarah . . .	Schooner	Liverpool . .	..	,,	N.E.	3,000	Total wreck.
1836	Jessie Stewart .	Sloop	Maryport . .	..	,,	E.	100	Stranded, but got off.
,,	Humphray . .	Ship	Bath U. S. . .	..	Squally	N.W.	3,000	Cast upon her beam ends, and cut away her masts to right her.
,,	George IV. . .	Brig	Glasgow . .	..	Strong breezes	E.N.E.	2,000	Total wreck.
,,	Shamrock . .	Schooner	Liverpool . .	..	Moderate	N.E.	150	Stranded near Maughold Head, but got off.

APPENDIX B.

ISLE OF MAN.

No. 157.

List of Wrecks on the Coast, 1822-45.

LIST OF WRECKS on the COAST of the ISLE OF MAN, 1822-45.—*Continued.*

Date.	Name of Vessel.	Rig.	Belonging to.	No. of Lives lost.	Wind. Force.	Wind. Direction.	Estimated loss on Vessels and Cargoes.	Remarks.
				RAMSEY.—*Continued.*				
							£	
1836	Hale . . .	Schooner	Liverpool . .	..	Strong breezes	N E.	1,000	Total wreck.
,,	Good Hope . .	Brig	Cardiff . . .	..	Moderate	N.W.	150	Struck on a bank about nine miles off Ramsey. Put into Douglas harbour for repair.
1837	Maria Crowther .	Brig	Whitehaven . .	..	Strong breezes	N.E.	1,200	Total wreck near Maughold Head.
1840	William & Betsey	Schooner	Liverpool . .	6	,,	N.E.	2,000	Foundered in Ramsey Bay.
,,	Tiger . . .	Schooner	Glasgow . .	..	,,	N.E.	1,100	Stranded and much damaged, but got off.
1842	Victoria . .	Steamer	Belfast . . .	..	,,	N.E.	16,000	Total wreck near Maughold Head.
,,	Henrietta . .	Sloop	Ramsey . . .	4	,,	N.W.	550	Foundered close in with Maughold Head.
1843	Johns . . .	Schooner	Newry . . .	..	,,	N.E.	600	Stranded and was much damaged, but got off.
1845	Mary . . .	Smack	Douglas . .	1	,,	W.N.W.	560	Sunk in Ramsey Bay, in consequence of the Schooner "Hazlewood" driving down upon her, when at anchor.
,,	Tryall . . .	Smack	Ramsey . . .	..	,,	N.E.	380	Total wreck.
,,	Hazlewood . .	Schooner	Sligo . . .	1	,,	W.N.W.	1,600	Total wreck.

SUMMARY.

Years.	Number of Vessels wrecked.	Number of Lives lost.	Estimated loss on Vessels, &c.	Years.	Number of Vessels wrecked.	Number of Lives lost.	Estimated loss on Vessels, &c
			£.				£.
1822	6	18	24,460	1835	14	1	17,870
1823	4	51	2,800	1836	7	..	6,500
1824	7	17	6,800	1837	3	..	2,600
1825	2	4	6,500	1838	5	19	5,760
1826	4	..	1,600	1839	5	1	2,020
1827	5	3	13,400	1840	13	8	12,042
1828	6	1	9,750	1841	5	..	1,490
1829	2	..	6,500	1842	8	4	17,345
1830	6	10	16,370	1843	5	..	2,100
1831	5	3	2,120	1844	2	..	250
1832	2	3	1,300	1845	8	10	20,790
1833	9	6	10,320	1846	1	..	600
1834	10	13	58,560				
				Totals	144	172	249,787

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No. 158.

Evidence taken on the 13th Oct., 1845.

No. 158.

PORT OF LANCASTER.—RIVER LUNE.

Examining Commissioners—RICHARD GODSON, Esq., Q.C. and M.P.; Capt. WASHINGTON, R.N., and F.R.S.

Present:—E. D. SALISBURY, *the Mayor;* JAMES ATKINSON, HUDSON BATEMAN, E. D. DE VITRE, T. H. HIGGIN, JOHN BOND, SAMUEL GREGSON, JOHN BOND, jun., JAMES JOHNSON, GEO. BURROW, E. DAWSON, J. ARMSTRONG, S. E. BOLDEN, S. SIMPSON, W. JACKSON, T. HOWITT, J. BROCKBANK, E. SHARPE, W. SATTERTHWAITE (Leonard Gate), J. SHARP, R. HINDE, and J. FEARENSIDE, Esqrs.; the Rev. T. MACKRETH, and Major MACLEAN, *one of the Directors of the Lancaster and Carlisle Railway.*

(On the table were copies of the Admiralty Survey of the Lune Estuary and Morecambe Bay, made by Capt. Denham, R.N., in 1844; a large diagram, representing the proposed harbour at Poulton Ring, and other charts connected with the port and its approaches.)

Mr. J. WALKER, examined.—I have been secretary to the Quay Commissioners since 1835. There are four Acts of Parliament for the regulation of the port. The governing Act is that of 23 Geo. II., c. 12. There have been three since that. One was for erecting a lighthouse; one for making docks; and another for borrowing money and amending the other two. The Commissioners are appointed by the shipowners of Lancaster. Every person possessing one-sixteenth of a 50 tons vessel has a vote. There are 16, exclusive of the mayor, who is a Commissioner *ex officio*. They are elected every three years. They were elected on the 7th of May this year. Did not recollect that any complaints had been made respecting the harbour. The Board had not, that he was aware of, received complaints from shipowners and other parties interested in the

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navigation. Was secretary, treasurer, and harbour-master. Had a book which contained the amount of tonnage up to 1844, including the number of vessels, and the sums paid for tonnage.

Years.	No. of Vessels.	Tonnage.	Dues collected. £.	s.	d.
1826	413	27,098	945	14	8
1831	523	35,664	1,113	14	5
1836	629	41,857	1,276	11	9
1840	1,507	76,949	1,497	0	2
1844	182	35,591	943	18	5

There were 314 vessels in 1840, however, which were principally stone-laden for Fleetwood, and this was an extraordinary case, not likely to occur again. The grain and timber trade had fallen off very much at Glasson. The accounts are examined every month, and audited every six months by the Commissioners themselves, according to the Act of the 23 Geo. II. The accounts were audited on the 7th of May last, and seven Commissioners were present. Five are a quorum. The accounts are not published. The shipowners and others paying dues have made no complaints of this mode of keeping accounts. Witness is harbour-master, but is not a sailor. His duties were to attend and see what vessels were coming up, to charge tonnage, and to berth vessels, and see them properly secured. Had been acquainted with the port of Lancaster ever since the year 1807. Had been in the habit of going down the river occasionally. Very little improvement had been effected in it, except the reduction of Scale Ford. This was 20 years ago. In 1840 the income was 1,490*l.*; it was expended in the general extension of the port; 598*l.* were paid for repairs and salaries; the salaries were 172*l.*; the rest was expended in great works. 1,256*l.* were laid out for a graving dock in 1840; it was a very great improvement indeed. There had been a great deal laid out in docks and walls; the graving dock cost between 3,000*l.* and 4000*l.*; the old wall at Glasson fell down, and cost 1,100*l.* rebuilding; it was originally formed by the Quay Commissioners out of the revenues of the port, and by money borrowed by them for that purpose. The debt was now 4,100*l.* The Custom-house was built by the Quay Commissioners. A great deal had been laid out on the quay walls, and on the pitching of the road-side to Glasson. When witness first came into office, the debt was 7,300*l.*; the interest paid on it was 4 per cent. The Commissioners had now 1,000*l.* in the bank. The new quay, which was built 30 or 40 years ago, had cost many hundreds; it is of stone. One corner of it gave way five or six years ago, and it was rebuilt by the Commissioners; the old quay wall had been repaired at several hundred pounds' expense besides; this was about three years ago. The wall which had been taken down and rebuilt was on the quay side, opposite the Custom-house. The dock walls at Glasson had also been repaired. The Commissioners had had a survey of the river, which cost between 400*l.* and 500*l.* It was made by Mr. Stevenson, with the view of attempting to improve it, in 1840. The report had not been acted upon for want of means to carry the improvements suggested in it into effect. It was published in the local newspapers at the time, so that all the shipowners belonging to the port were acquainted with it. It was also printed in a pamphlet and distributed. The plan was considered by the Board, and it was found that they had not means to carry it out. The highest estimate was 13,000*l.*, and that for a partial improvement 7,000*l.* Was not acquainted with other ports of the kingdom. Had heard that where improvements had taken place, as in Glasgow, there had been a greatly increased traffic. Knows of no other thing likely to affect the port except the railway. The Commissioners had put down two jetties, not under the superintendence of an engineer, but under that of the clerk to the Quay Commissioners. One was that opposite to the quay, and had been found to do a great deal of good; the other was near Marsh Point. There was a great accumulation of sand there at the time, and it now accumulated sometimes; it was brought from the sea by the tide; what came down the river was deposited by the old bridge.

COMMISSIONER.—I have seen a vessel with a cargo of wheat actually stranded near the quay in consequence of the sand, and they were unloading her that she might float as the tide came up.

WITNESS.—Recollects a vessel with iron once in that state, but did not recollect any with wheat; a great fresh generally removed that sand; the freshes carried away more than they deposited; they took the sand right away to sea; did not think it was deposited on any bank as it went out, as the tide carried it away. Freshes occurred a good deal in this river in winter time; sometimes three or four times in a month. They had never overflowed the quays within six or eight feet; there were sometimes six feet of fresh on the fords; the spring tides were above a foot below the new quay; the quays were never covered with the fresh, except in a great storm. Once it was up to the Custom-house door, but that was not owing to the fresh, but to the high wind. There are no obstructions in the river to prevent the tide coming fairly up and going down. There is a weir at Salt Ayre; there is also one at the mill-side at Skerton, with locks to catch fish and let the water through. Should think it is six or eight feet above the bed of the river. Supposes it was erected by the owners of the Halton Fishery. Does not know how it was erected, or by what authority. The lord of the manor might have a right to do it, but witness did not know. The high tides would flow far above it if it were not there. Considers that the fresh is most useful in coming down a river, for the tide leaves a deposit. If the tide went up above Halton weir, it would not have sufficient force in coming down, with regard to the scour. The engineer, who was consulted about the port, never had his attention called to this. The Quay Commissioners confined their limits to the old bridge. They would claim tonnage if a vessel went up higher to discharge. They are conservators of the port. These dams [weirs] were a little obstruction, but not a great deal, because the water flows over at high tides. There was another weir a mile or more higher up; the tide would undoubtedly go up the river if that weir did not exist. There are two weirs at Halton, and another at the end of the Ladies' walk; supposing they were all removed, the tide might reach there, but not much further. There was one weir at Skerton, and two at Halton; there was also one called Dalton dam. There was the old bridge, but did not consider that an obstruction. Sand deposits above it, but it is tidal sand. Part of the old bridge was in a very dangerous state, and liable to fall into the river at any time. The Quay Commissioners had nothing to do with it; believed it was private property. The Quay Commissioners' jurisdiction was from the old bridge down to the Perch. There are three or four

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weirs or dams altogether. That near the new bridge is a quarter of a mile above the old bridge. It must obstruct the flow of the tide. It did not cause deposits above it. There was a proposal for erecting a railway bridge brought before the Commissioners; it was taken into consideration; there was a public meeting in the town, which appeared to be in favour of it, and the Commissioners gave way to that feeling. It was thought that a certain amount of damage would be done, but that the advantages would be greater. Permission was given to build the bridge, and what they asked the company to pay was a considerable sum: it was a large one, indeed. 16,500*l.* was granted for the damage done to the quays and warehouses; there was nothing for the river, and nothing for the navigation. There was a good deal of opposition made to this bridge being put across the river, but, upon the whole, it was considered for the good of the town. Nothing of that sum had been laid out. There was a difference of opinion as to how this money was to be laid out. Some wanted to begin improving at once, and others did not. The port would be deprived of a certain amount of quay accommodation, and it was proposed to replace it immediately below the railway bridge. A vessel of 212 tons, laden with oats, had come up to the quay; vessels of 500 tons and upwards came up to Glasson dock, but not to Lancaster. Captain Coupland was the only one among all the 17 Quay Commissioners who was a sailor. The affairs of the port and river were managed by different committees. Captain Coupland was on the dock committee, and on the pilot committee. Within his recollection there had been a large tract of 100 acres enclosed on Aldcliffe Marsh, by Mr. Dawson of Aldcliffe Hall; this was about 20 years ago. It was not done by Act of Parliament, or any other authority, except Mr. Dawson being the owner of the nearest property.

Mr. J. HIGGIN here explained that Mr. Dawson had bought this identical piece of marsh land of Mr. Ridley, the previous owner of the Aldcliffe estate, and paid him a handsome sum for it.

WITNESS.—It was below high-water mark. The Quay Commissioners would think themselves bound to prevent an embankment, in case they thought it would be in any way injurious to the river. They had refused to let Mr. Brockboles put a stone pier down, which would have projected considerably into the river. The corporation land extends to Marsh Point, and this was just below it. This was in 1797. There was a small marsh opposite Scale Hall which had been enclosed; it might be probably 20 acres. This was done 30 or 40 years ago.

Mr. ARMSTRONG asked witness why the remaining arch of the old bridge was built up; was it not in the hope of a beneficial effect, and proved to be an evil.

WITNESS.—It was 14 or 15 years ago since the arch was built up. A small wooden weir had been run out on the Skerton side of the river, opposite the Custom-house, by his father. There was one also at Heaton Marsh; they had run it out to straighten the current, and it had had that effect; the bag and poke-nets have frequently injured the river. They had been ordered away. They had only been put there within the last few years, except Scotch balks. Both had caused a great deposit of sand in the river. This was against the wish of the Quay Commissioners, who had removed them once, but the parties to whom they belonged set them again. There is a balk belonging to the Duke of Hamilton, just above Conder. The aqueduct bridge was erected by the Canal Company for their own accommodation. Does not consider it much of an obstruction, as they were very large arches. Should think they were larger arches than those of the new bridge, but not so wide as those of the new railway bridge; but there were five of them, and only three at the railway bridge. Should not think the aqueduct bridge much of an obstruction, even if Skerton weir was down. The pilots belonging to the port are under the jurisdiction of the Quay Commissioners; they do not pass any examination; they are asked a few questions by the Quay Commissioners, and then receive their licence. There are three sea pilots, and four river pilots; they do not pass any particular examination; they have a licence given them if they are of good character. They pass no particular examination, except asking them whether they are acquainted with the river. They have testimonials from the shipowners. The navigation up to Lancaster is intricate; the wind blows to the southward great part of the year, and makes it difficult for vessels to get down again. The Walney lighthouse was built 50 or 60 years ago. The dues vary from 150*l.* to 200*l.* a year. It is a revolving light, once every five minutes. The Quay Commissioners fixed the period of revolution. The Trinity House made an inquiry once as to their mode of management and expenditure, and they gave them the return of both for many years. Considered the light a coast and harbour light. Thought there should be a general tonnage from all vessels which passed it. Does not know that it should be under the control of the Trinity House. Has no doubt that if the Trinity House had thought it would be a profitable thing, they would have taken it from them. Had had complaints of the period of revolution being too long. If it were thought necessary to alter the time of revolving, they would have the power to do so. There are no leading lights up to Glasson. There is a steamer connected with the port; she comes up sometimes in the dusk of the evening, but not at night. The want of lights had been complained of greatly at Glasson Dock, and the Commissioners had had Mr. Hartley from Liverpool to see about two new ones being put there; this was three months ago. If the docks were removed, as was talked of, only one would be wanted. Had heard it said the Glasson docks were at present inconvenient. Had seen many vessels which should have sailed from that dock with a fair wind, when they got outside, but they could not get out on account of the north wind blowing strongly inside. Does not know how many acres the dock is; it will hold very large vessels four in a tier. There had been very considerable deposits of mud at the entrance of the docks, and the Commissioners wished to clear it away by diverting the current of the river. This was done at a cost of between 130*l.* and 140*l.* It was done by putting down some planks; the same might be done with regard to the deposits on the town quay, but they thought that the fresh would take it away again. When it became too bad, the Commissioners had to take it away. When the shipowners could not get up, they complained to him, and he sent men to clear it away. The quay is not in a good position, but it was perhaps the best that they could make in those days. The Lancaster and Carlisle Railway is to cross the river. There was a scheme for making docks of Poulton. Had also heard it reported that docks were to be made at Thorn Bush, and a railway from there to Ellel, three miles from that place; they were to unite together. There is also Mr. Stevenson's scheme for the improvement of the river. There was also a North Western Railway proposed, and that might make some difference to the port.

The Quay Commissioners were going to renew the land-mark at Rossall Point. It was originally erected by them on a small piece of land belonging to Mr. Hasketh. It was partially

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undermined, and they had applied to Sir Hesketh Fleetwood, to see if he would consent to extend the lease. He agreed to do so, on condition that they paid him 2*s.* 6*d.* a-year as ground-rent, and a penny a ton on all vessels which passed between Rossall Point and Walney lighthouse, which would amount to between 300*l.* and 400*l.* on the renewal of the lease every seven years. This was objected to by the Commissioners. That land-mark would be useful to both Fleetwood, and Lancaster, and Ulverstone vessels. The port was not sufficiently buoyed, and it had been determined to put down a new north-western buoy. Two new lights were also under the consideration of the Commissioners. They had received no other report besides Mr. Stevenson's, except that about Poulton Docks. The Quay Commissioners had had a copy taken of the late Admiralty Survey. No ballast was thrown overboard. He was careful to see that the tarpaulins were spread, to keep all clear; had power to inflict a penalty if this was not properly attended to. Capt. Beazley had been here some time ago, and proposed to improve the river by placing a kind of hurdles down the sides of the channel, which would get covered with sand, and he then proposed to lay another row higher up, so that the channel might be narrowed. Does not know why the Commissioners refused to adopt this plan. Knows that the Clyde had been improved by means of these dykes and dredging.

Mr. DAWSON.—Did not Capt. Beazley propose to do all the river down to Glasson Docks; and did he not send in a report to the Commissioners?

WITNESS.—The Commissioners did not think that it would be of any good. Capt. Beazley merely attended their meeting, and stated to them what had been done in the Welland and other rivers under his superintendence.

COMMISSIONER said it must not be imagined that large and very costly works were always necessary for the improvement of a river. Fascines might prove more useful than blocks of granite, and he thought it very probable that this river would have to be fascined all the way down. Did witness think that the Fleetwood Railway would injure this port?

WITNESS.—Had no doubt. It proposed to come past Glasson Dock, through the Duke's property, and through Mr. Dawson's property, but he did not know where it would join. It must cross the line at Thorn Bush. They are two different concerns.

Ald. BROCKBANK said, that seven or eight years ago there was a very dry summer, and the river was nearly sanded up opposite the quay; but they had had no land-floods, and it was the land-floods that kept the river clear.

Mr. DAWSON wished to corroborate what Mr. Brockbank had stated as to the scour of the river. In 1806 the navigation was obstructed simply from the want of freshes. He had no doubt, that if Capt. Beazeley's recommendattion had been carried out, the navigation of the Lune could have been improved to any extent. If this could be done in the river Welland, where there was only a fall of a foot in two or three miles, surely it might be done here, where there was a fall of eight or ten feet between the quay and Glasson Dock.

COMMISSIONER.—Supposing that the tide was allowed to run up to Skerton, would not that be better?

Mr. DAWSON said there was much difference of opinion on this point. The river was not affected by the high tides. They seemed more to impede the navigation than to improve it. He did not think that if all the weirs were removed it would increase the scour. The fresh water which came down the river was the scour, and not that brought up by the tide.

Dr. JAMES JOHNSON said, that it was owing to the full stream of the river running on the north side that such an accumulation of sand was caused on the south side, near the quay steps; and that if the steam could only be turned to that side, it would sweep the sand away.

The COMMISSIONER then referred to Messrs. Stevenson's first report, and said—I see it here stated, that in spring tides the tide takes an hour and fifty minutes to flow from Glasson to Lancaster, and in neap tides five hours; and yet you say that the tide has fair play. The tide is stopped on its way owing to the obstructions in the bed of the river. There is, in fact, no tidal scour.

Mr. T. H. HIGGIN.—Supposing that the weirs were taken away, so that the tide had free access up the river, and that the river was deepened as suggested in Messrs. Stevenson's report, would there not be a very considerable tidal scour where little or none now existed?

Mr. DAWSON certainly thought that the channel could be improved below; but had considerable doubts, even if the tide were carried up, as suggested by Mr. Higgin, that it would increase the tidal scour. He doubted very much whether the throwing up of a large quantity of waste would increase the scour. All that was wanted, in his opinion, to improve the navigation, was to narrow the river and deepen the channel.

Mr. E. SHARPE thought that attention should be paid to the opinions of Captain Denham and Mr. Stevenson, who both agreed that narrowing the channel of the river from Sunderland to Lancaster would improve it for that length, but that there would certainly be disadvantages outside that point, which was more important to the navigation of the river. "The great object," said Mr. Stevenson, "to be kept in view, in carrying into effect the improvement of the navigation of the Lune, is the free admission of the greatest possible quantity of water from the sea, as reliance must be chiefly placed on the scour produced by the tide, and not upon the current of the fresh water, as the chief agent in keeping open the navigable channel of the river."

RICHARD GERRARD examined.—Had been a pilot for the last twelve years. The sands between Glasson Dock and Lancaster were continually shifting. The tide came up only three miles and a half in the hour. It rose very slowly in neap tides. Is a river pilot. Is acquainted with the approaches to the river. Those approaches are not sufficiently buoyed. There ought to be five buoys, instead of four. The two outer buoys are right enough, but the other two were not placed at the right points. Witness's brother and other pilots placed them. The pilots choose that which they think the best place. The pilots outside are authorised to change them, if they think they are not right, on application to Mr. Walker. They are changed every year. The two inner buoys were too far distant.

Mr. W. WELCH.—The Quay Commissioners had come to a resolution that morning, to put down a large iron buoy in addition to the present north-west buoy, and that the others should be placed at equal distances.

WITNESS.—Could not say there had been many wrecks for want of buoys. The buoys were large enough. They were very good buoys indeed. There were very few better buoys anywhere.

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Some small tide-lights were wanted. One should be placed at the Abbey Perch. Would consider four or five hours sufficient for them to burn. Cannot say what the expense would be. Did not think it would be much. A vessel could be run in safely if she had these lights to go by. Nothing could come in till half-flood. The sand-banks extend from Sunderland bank down to a distance of six miles. They did not shift much. They were principally hard sand. Should think that if a good scour was kept up it would tend to deepen the river. There was not the least doubt that if a great body of tide-water was to come up to Lancaster, and to go down again with all its force, it would tend to scour the river thoroughly. Vessels waiting for a tide to take them into port generally anchor at the north-west buoy. There was good anchorage there. Never knew a vessel drive from it in his life-time. There are some patches on the north side which are dry at low water. They are called the Foul Ground. Cannot say that if a breakwater was made there, vessels would be better protected. A few wrecks have taken place at the mouth of the river, but cannot say how many. There had been none since the "Yeoman," three or four years ago. The Walney Light was a very good thing. The "Fame," a small coasting vessel, struck on Sunderland bank, and sprung a leak. The "Alert" brig was also wrecked in 1838. There was no pilot on board that vessel. There are plenty of pilots here, but these coasters do not take them till they get outside. They are not tied to have a pilot, except they exceed 100 tons.

Mr. J. **SHARPE** here handed to the Court a written list of wrecks which had taken place in the neighbourhood of the port within the last few years. His object, he said, was to show that, if there had been safe anchorage for them, they would have run in for safety.

WITNESS.—Recollected the "Favourite" being lost, but no one knew where. She went down at sea.

COMMISSIONER.—Do you know anything of the "Favourite" being driven on the rocks opposite St. George's Quay, and filling with the next tide.

WITNESS could not say that he took much notice of such trifles. Had heard complaints of Walney Light being too long in revolving. In 1844, the "Scamper," of Maryport, was harmed a little on the Foul Ground, and was towed into Fleetwood. She became totally unmanageable She had not a pilot on board. There was no beacon or buoy on the Foul Ground. Something of the kind would be very desirable. The buoy on that ground ought to be a very large one. One on the Perch would perhaps be better. Remembers the "Rambler," of Liverpool, going down opposite Walney Island. Piel Harbour is considered a very good one, after you once get into it. Recollects the "Surprise," of Fleetwood, being wrecked on Sunderland bank. The "Thomas Burrow" was also lost, in going from Glasson to Sunderland, a good many years since. She was running down with the tide, without a pilot. There were none to be had that morning. The pilots went out in decked boats. They have one at Piel, and another at Fleetwood. They are both Lancaster boats. One is found by the Quay Commissioners, and the other by the pilots themselves. They merely lay out there to be in readiness. These wrecks might have been avoided if there had been improvements made in the river, such as putting the buoys nearer together, and putting something on the Foul Ground as a buoy. Cannot recollect anything else. The Fleetwood Light is a very good thing. There ought to be a light on the Abbey Perch. Nothing could be done between Sunderland port and Lancaster, without narrowing and deepening the river. It would then bring ships up to Lancaster Quays. The best place to berth them was about the new quay, or above it. They are all safe then. Would bring them up to the old quay, if there was water sufficient. If the railway bridge was built, and another quay made, it should be joined to the new quay. If the shoals could be removed, there would be nothing like coming "chock up." The bottom of the new quay is gravel. There are a few stones. Vessels lay there very well when there are no sands. Ships do not often receive damage there, but they get stranded sometimes by laying when the tide is washing down the river. Cannot say what his brother pilots would say. The "Norge," a Swedish vessel, was wrecked in Heysham Lake. She struck on the Foul Ground, there was no doubt. Glasson Docks ought to have been built at Sunderland Hole, on the east side of the river.

Dr. **JAMES JOHNSON** said Sunderland was the old port of Lancaster.

WITNESS.—Sunderland Hole would have been much better than Glasson Dock, because vessels would not have to lay there a week, as they had to do sometimes at the north-west buoy. Nothing could be done without deepening the channel up to the dock. It would not be safe to lay there. There were fourteen feet at low water. The bottom was a soft sort of marl. Had seen marl come up on the peak of the anchor. If the beck between the Cocker and the Lune were cut across, vessels could run into the Cocker, but that was no place at all.

ALEXANDER KENNEDY examined.—He said he was master of the "Duchess of Lancaster" steamer, and had been trading with the port for the last six years. There had not been many changes in the river. There had been one from the north-west buoy to Glasson Dock. Had known no change for the improvement of the port. There are many sand banks in the river, which were shifting a little. Is in the habit of running up and down the river, and had known the sands shift from one side to the other. Sometimes they shifted with dry weather, and when the fresh came down they shifted again. Would recommend another buoy or two, say two, near the approaches to Glasson Dock. Had mentioned the want of such a buoy to the pilot Gerard, but never to the Quay Commissioners or their secretary. Would have the other buoys placed rather differently. Would have a leading light on the Abbey Perch, and shifting lights in-shore. Looking at the traffic of the port of Lancaster, thought it required such lights. It would make it much safer for ships from the West of Ireland. A great many strange vessels dare not come up the river for want of such lights. To come up himself, witness was obliged to light the Perch. Does not know that this is done elsewhere. The steamer paid more dues than any one else, and witness thought she ought to have special accommodation. If a half-tide light was lighted, a vessel drawing only ten feet of water could run in with safety. He would have a small light at Sunderland, besides the Perch, and another at Glasson Dock. The Walney light was too long in revolving. It was sometimes from four and a half to five minutes. Out of the whole five minutes it only showed little more than twenty seconds. If running up in a snow-storm, no vessel could make sure of it. Knows no other in the kingdom that takes five minutes to revolve.

COMMISSIONER.—Nor anybody else anywhere in the world.

WITNESS.—A breakwater at Foul Ground would be of great advantage to the port. Vessels coming from Morecambe Bay to Lancaster might anchor on either side of it in safety. Had gone

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up to Poulton in the steamer. Had no difficulty in running up. If he had the depth of water as laid down in the charts, there would be no difficulty in running up to Poulton Ring. It would be the means of saving many vessels. Thinks it would be more desirable to bring ships up to Poulton Ring than to Lancaster. The least water he had in running up there, at low water, was two fathoms and a half. They are twelve hours out of every twenty-four in getting up to Lancaster. They could run up to Poulton when they could not get up to Lancaster.

COMMISSIONER.—Is there any one present acquainted with the project of making docks at Thorn Bush?

No answer.

Mr. T. H. HIGGIN said he was appointed a Quay Commissioner in 1827, and had continued in office up to this year. In 1829 he brought before the Quay Commissioners the necessity of improving the river, and through his instrumentality obtained permission for the Messrs. Stevenson to take a survey of it. They were accordingly employed, and their report was before that meeting. That report would speak for itself; and he hoped the Court would that day have an opportunity of inspecting the enlarged plan laid before the Quay Commissioners by Mr. Stevenson. He would put it to all present whether, if these improvements were carried out, and a light placed on the Abbey Perch, the navigation would not be much improved, and whether another dock might not be advantageously constructed lower down the river. At present vessels had to warp in and to warp out. Mr. Stevenson had stated that for a sum not exceeding 13,000*l*. the navigation might be improved so as to allow ships drawing 16 feet of water to get over Scale Ford; but the Quay Commissioners differed with him in opinion, so nothing was done, and the scheme had been shelved ever since. Now he understood that there were two sums, one of 10,000*l*., and the other of 16,000*l*., paid as compensation by the Railway Company. Now, if these two sums of 16,000*l*. and 10,000*l*. were laid out in the improvement of the Lune, vessels could come up to the bridge and discharge their cargoes in safety. This was the idea which was entertained at the public meeting on this subject; but at present there was a scheme for taking vessels up to Poulton Ring that interfered with it. But by the improvements recommended by Mr. Stevenson, and by extending the quays, sufficient accommodation would be provided, and it was here they ought to lay out the money, instead of going to Poulton Ring.

Major MACLEAN thought there was a letter from the Admiralty to the Lancaster and Carlisle Railway Company on the subject, in which they did not insist so much on its being applied to the deepening of the Lune as the general improvement of the port and its approaches

Mr. T. H. HIGGIN said the Act of Parliament declared that it should be expended in improving the river between Lancaster Bridge and Cockersands Abbey: and it was quite clear that the Quay Commissioners could not levy dues beyond those limits. If these improvements were carried out, vessels would be secure enough if brought up to the railway bridge. The original intention was that the quay should be contiguous to the railway station, so that vessels might be loaded and discharge their cargoes with all possible facility. He had taken the trouble of ascertaining the cost of a quay to the same extent below the bridge as it was now above it, and had made it out that there would be 4,000*l*. or 5,000*l*. left to be devoted to the improvement of the river.

Mr. WALKER had lately received 8,000*l*.; and he thought there would be something left for improving the river after compensating the owners of property, and rebuilding the quay; perhaps 4000*l*. or 5000*l*., as stated by Mr. Higgin, and when this was added to the 10,000*l*. they would be able to make it a very navigable river, with sixteen feet of water at high water.

Mr. T. H. HIGGIN said the Commissioners had previously ascertained what the warehouse owners would take for their property, and the sum did not exceed 5,000*l*.; and as to the other claims that had not been substantiated, they were only trifling, so that there would be above 4,000*l*. remaining for the improvement of the river.

Mr. HINDE said Mr. Higgin laboured under a very considerable error as to the amount of the claims. They amounted to 6,500*l*. After defraying these and building the quay, he had at first been of opinion that there would have been a surplus; but after consulting with Mr. Gregson, he had come to the opinion that there would not be a single pound left to devote to the improvement of the navigation; and further than that, that the Quay Commissioners would be greatly out of pocket.

Mr. DAWSON wished to make one remark to corroborate what Mr. Higgin had said respecting the navigation of the river. He was very much surprised to hear that the report of Capt. Beazley had not been laid before the Commissioners. Which of the two should be adopted, his or Mr. Stevenson's, was a mere question of expense.

Major MACLEAN had one or two observations to make as to the deviation by the Lancaster and Carlisle Railway Company of their line to the west of the town. He had no authority to make any proposition on their behalf, but he might state that they had given their money without grudging, and that while they thought the 16,000*l*. ought to be left to the Quay Commissioners, they could not hold that the 10,000*l*. were equally at their disposal. The company gave it to the Admiralty, and whatever that body might do with it, whether it was devoted to improving the approaches to Lancaster, or otherwise employed, so as to promote the trade of the district, would be satisfactory to them. He might also add that the company were willing to adopt any of the works that tended to the improvement of the port, and that whatever projects were agreed on, they would always be dealt with by them in a liberal spirit. He wished the Tidal Harbours Commission to see that the company had no limited views, if they could see their way to ultimate advantage.

Mr. E. SHARPE said the plan with which he had been entrusted was of so important and extensive a nature, that he regretted it had not been confided to one more competent to do justice to its merits. It was no new plan to the inhabitants of Lancaster. It was known to them in another form fifty years ago; and had been a matter of interest and study to him for the last five or six years. This plan had been reported upon favourably by three of the most eminent nautical surveyors of the present day. It had received the unqualified approbation of that body which had been appointed to watch over the interests of the port of Lancaster, and who had given it their sanction in a resolution passed at their last meeting. This project had also received the promised assistance, both parliamentary and pecuniary, of three powerful railway companies; and it had likewise received the approval of nearly all the principal tradesmen of Lancaster. It was about to be brought forward and laid before the next Session of Parliament, under the auspices of fourteen gentlemen of the highest respectability and standing; and it therefore had a strong claim on this ground upon their attention. Now, in alluding to the plan of their opponents, he wished it to be distinctly understood, that if he felt called upon to speak in strong terms of that plan, he meant no personal disrespect. This project was not like the one to which he had just adverted. It did not propose to remove the port of Lancaster three quarters of a mile further from the town of Lancaster, but, on the contrary, to make the port and the town identical. It did not propose to carry a line of railway from a new dock, six miles distant, to another point on another railway equally distant from the town; but, on the other hand, to bring a ship canal from a deep water channel, three and a half miles distant, up to the town itself. It did not propose to shut up or abandon the navigation of the Lune from Thorn Bush to Lancaster; but to open the upper part of that navigation to a trade and a traffic it had never hitherto known. These might be said to be the local inducements in favour of this project; but he laid claim to considerations of greater importance in a national point of view. If they looked at a map of England, they would find that the line of coast bewteen Holyhead and St. Bees formed a large natural bay, from which ships could not escape, under certain circumstances of weather, at low water, inasmuch as all the rivers which discharged themselves into that bay were so encumbered with shoals and sand-banks at their entrance as to be virtually closed at low water, and in stress of weather a vessel had no point of safety or shelter to fly to. This would be scarcely credited when the value and amount of the shipping that daily leaves the port of Liverpool alone was taken into consideration; but such was the fact. It was still more remarkable, that in the centre of that great natural bay, in the hollowest part of it, namely in Morecambe Bay, there was a channel, deep, broad, direct, leading to precisely such a place of safety and shelter. It was unaccountable that this channel had remained so long unnoticed and almost unknown. It was Sir Edward Belcher who first pointed out the manner in which this channel might be made available for the very purposes to which it was proposed now to adapt it. It was to Captain Denham's admirable survey they were indebted for the knowledge of its extent and capabilities. They were indebted also to Mr. David Stevenson's excellent report, by which they were shown how they could accomplish the ends recommended by Sir Edward Belcher and Captain Denham: and from that eminent civil engineer, Mr. Rendel, they hoped to hear a confirmation of the opinions of these gentlemen when they were referred to him, as they no doubt would be, by the Admiralty. This was the principal object of the undertaking, the establishment, namely, of a harbour of refuge, accessible at all times of the tide, and in all weathers; and on these grounds they hoped for the approbation of the Admiralty, as well as of the Tidal Harbours Commission and the Trinity Board. The next object of the undertaking was the construction of a tidal basin in connexion with this harbour of refuge, the sill of which should be on a level with low water of the Irish Sea at a twenty-eight feet tide, which will make that sill lower by eight or ten feet than that of any dock in Liverpool. Next it was intended to carry a ship canal from this tidal basin into the Lune, and to construct weirs across the Lune, so as to present permanent high water at Lancaster Quay-side, that large vessels might load and discharge their cargoes under the eyes of the consignees. Thus the unusual sight would be presented to an inhabitant of Lancaster of a large vessel afloat in a position and at times where there are now only eighteen inches of water. Mr. Sharpe here called attention to a diagram he had prepared from Captain Denham's chart of the coast, showing the aspect of the bay at low water of a twenty-eight feet tide; and said, a vessel, for instance, approaching from the Irish Sea had a simple piece of navigation to perform, and every mariner would tell them that when she got beyond the Fisher Bank patches, she was beyond the fetch of the Irish Sea, even at high water, and had an excellent channel before her, three miles broad at the widest, and half a mile at the narrowest, and that within three-quarters of an hour of his arrival at Poulton pier-head, he was at Lancaster Quay side. Let this be compared with the difficulties which the mariner had to encounter in navigating the Lune, the most insurmountable of which lay between the north-west buoy and Sunderland Hole. According to the opinions of Captain Denham and other nautical engineers, it was impossible ever to improve that part; and any one who would carry his eye from the north-west buoy along the sandy, encumbered, narrow, tortuous channel of the river up to Lancaster, would perceive the great advantages of the proposed improvement. In reference to the permanency of the projected navigation, the whole evidence, traditional, documentary, and scientific, was unanimous. Captain Denham, in his examination before the Tidal Harbours Commission, gave the following evidence on this point:—

"898. Mr. AIRY.—Could you rely on the permanency of a harbour at Poulton?—Giving the term a century to range over, I should say there is every chance of maintaining it. There has been from time immemorial navigable water off Poulton Ring; cruisers that were looking out for smugglers, or to press men last war, took up anchorage there; but so little understood, that it has never presented the refuge it might within the limits of the bay. There is not a buoy or beacon, or light to lead to it."

Again, Mr. Stevenson, in his last report, writes as follows:—

"In looking into charts, in particular that of Murdock McKenzie, we find that the Grange Channel, of which it is proposed to take advantage, maintained its character as a broad and deep low water channel seventy years ago, which is an encouragement to expect that it will continue in its present state, so long as the backwater of Morecambe Bay, to which it owes its existence, is preserved."

A point of some importance in addition to this evidence is the fact, that an hour and a half before high water, a circuitous action is imparted to the water in the bay, which begins to recede on the Poulton or east side that length of time earlier than it does elsewhere; and this gave the large backwater so accurately described by Captain Denham, and alluded to by Mr. Stevenson, as the great scour of this channel. As to one circumstance alluded to by Mr. Thos. Higgin, that the Quay Commissioners' Acts of Parliament did not extend to Poulton, but were confined to the Lune, that was true; but what they proposed was, by constructing a ship canal from Poulton into the Lune, to bring all shipping within the reach of those very Acts of Parliament. This would get over the difficulty of the Act of Parliament. He thought, too, that Mr. Higgin would agree with him, that if the project of insuring, by means of this canal, sixteen feet of water at all times of the tide could be realized, it was the best that could be adopted.

Mr. E. SHARPE said he would also refer to the opinions of Messrs. Stevenson, in their second report on the improvement of the Lune (dated 30th September, 1845), after they had carefully considered Captain Denham's survey; and of whatever value the report of these gentlemen was in the first instance, the same value should now be attached to their preference of the project for improving the port of Lancaster generally. In carrying out the plan, there would be one weir at Scale Ford, and another on the east side of Salt Ayre. They would be laid, one of them on the north side, near Snatchems, entirely out of the reach of navigation, and the other in that part of the river where the shallows were least capable of improvement, as at Scale Ford. If the advantages of this place were embraced, he did not despair of seeing this one of the best ports on the western coast. There would be no diminution in the river: every bucket of water that poured down the Lune would still pour down, and therefore there would be no interference with Acts of Parliament.

COMMISSIONER.—Do you propose to put gates to your weirs?

Mr. E. SHARPE.—That is part of the project. This was a very different plan to that of establishing docks at Thorn Bush, a distance of six or seven miles. The promoters of that scheme intended to have a railway branch in connexion with the Lancaster and Preston Railway, to carry away all the traffic from the town. Now this was so great a blow to the traffic of Lancaster that it was time for the tradesmen to strike a blow for themselves; and he would engage, that in the course of a fortnight, there should be a memorial got up, and signed by a majority of the most respectable inhabitants, to avert that scheme, and declaring in favour of the one for bringing up the sea to the town. He did not wish to see the interests of the town, to which he was warmly attached, sacrificed to those of a private company. That company already possessed two modes of communication with the town, the canal and the railway, and now they wished to monopolise a third. In regard to the sea reach of the Lune, no engineer had yet ventured to propose any method of improving it short of embanking it the whole way down to the north-west buoy from Sunderland Point—an undertaking of too bold a character, he thought, for any Company to undertake. This was the opinion of Capt. Denham, R. N., who had devoted so much time and labour to the consideration of such questions; who had stated in his evidence and in this report, that he had known vessels drawing 15 or 16 feet, detained four or five days for sufficient water to lift them over that four-mile bar; and a steamer of eight feet draught, detained for hours, and exposed to the whole fetch of the Irish Sea, before she could enter it. One of the most eminent shipowners belonging to the port, who was then present, would tell them that two of his vessels had had their backs broken, and thus caused him a loss of nearly 3000*l*., for want of better approaches to the docks.

Mr. SHARPE then read from Capt. Denham's evidence before the Tidal Harbours Commission, the subjoined passages, relating to the sea-reach of the Lune:—

"868. CHAIRMAN.—Will you state your opinion?—Taking the Lune in its present outfall, we trace it down a sea-reach, through sands of four miles depth, obliquely to the flood and ebb-tide sets. As soon as I found what really was the shallowness and tortuosity of the sea-reach channel, it struck me as a hopeless case the maintaining the exit of the river Lune in any course that it had hitherto taken to itself.

"954. Capt. WASHINGTON.—What would you recommend, under present circumstances, for the improvement of the port of Lancaster?—I would recommend abandoning the Lune to its present course *in toto*, and making available the arm of tidal water that now exists up to the Poulton Ring, which will bring a ship or packet at low water spring tide within three miles of the town, instead of leaving her at anchor for hours, and sometimes days, eleven miles from the town."

He had now detailed the outline of the advantages of this scheme, and the disadvantages of the other, and he trusted that the Admiralty would take the case into consideration, so far as to direct that the sum to be expended in the improvement of the Lune should be laid out, not in the improvement of that part of the river that was farthest from the town, but in that part of the river which was nearest to it; and in some such manner as that proposed by him. He hoped, in eight or ten days, to be able to elicit a strong opinion on the part of the town of Lancaster on this subject; and the only evidence that now remained to be given on it was that of Mr. George Burrow, one of the oldest merchants of their port, and that of Mr. Burrell, an extensive timber merchant, who would inform them that, in consequence of the great disadvantages of the present mode of entrance to the port, they had refused, at Liverpool, to insure his vessels further than the north-west buoy.

Mr. BURRELL said that on taking off the deck load, the Insurance Company did not make this distinction. He had five vessels, varying in burthen from 300 to 600 tons, discharging cargoes at Glasson Dock, and it was not often that they could get out, owing to the narrowness of the channel. They were generally towed out by steamers, and if they could not get the "Duchess of Lancaster," they had to procure one from Fleetwood. I do think it would be of great advantage to Lancaster to have a deeper channel.

COMMISSIONER.—Would it be of advantage, in your judgment, to bring vessels to Sunderland Hole?

Mr. BURRELL.—Sometimes it might be, but there is not room for vessels to swing there. Our vessels can only lay out at the north-west buoy. Would have saved two ships by this canal, if it had been made. Would be willing to pay an extra sum, if it was only a reasonable one, for such accommodation. Had paid about 120*l*. this year for tonnage dues. Two years ago had the "Lavinia" and "Sarah Ann" stranded, one within 200 yards of Glasson Dock, and the other within 300 or 400 yards. The damage was between 3000*l*. and 4000*l*. They broke their backs. The accident was not owing to want of skill in the pilot, but want of water in the channel. One of these vessels was piloted by Charnley. Is not aware that the accident occurred in consequence of the pilot bringing her too early up in the tide. The principal difficulty lies between Sunderland and Glasson Dock. If a commodious dock were made at Thorn Bush by any parties, many vessels would be able to run to that dock. There was a difference of six feet there. The general slope from Lancaster to Glasson Dock was about two feet in a mile. By no means wished it to be understood that the channel of the Lune was a good one, for if a vessel was brought to the dock at Thorn Bush, and the wind was to fail her, she would go on to shore there. There are 12 feet of water at Thorn Bush in neap tides, by Capt. Denham's chart. Had never seen better accommodation for the timber trade than that afforded at Glasson Dock. His argument was, that Glasson Dock was a very good place if you could only once get into it. Does not remember 40,000*l*, LANCASTER.

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being spent on that dock. Recollects hearing that the docks were originally proposed to be built at Thorn Bush.

COMMISSIONER.—Then how came they to make docks at Glasson?

Mr. J. HIGGIN.—The Glasson people were beforehand. Glasson Dock was placed in its present situation in consequence of a violent party contest.

Mr. GEORGE BURROW examined.—His opinion of the proposed improvements agreed with what Mr. Burrell had stated. There were a great many difficulties in coming from the north-west buoy, but greater from Sunderland Point. The formation of docks would save these, but does not think that Thorn Bush can be put in comparison with Glasson Dock. Glasson Dock is in the worst situation that it can be. Had been connected with the trade of the port 40 years. Vessels could not get out of Glasson without a deal of trouble. If a dock were made at Thorn Bush it would be merely an abatement of the evil. Had known vessels come into Glasson while the tide was coming, and they could not get back. There could be no doubt that there was a greater depth of water at Thorn Bush.

Mr. J. SHARPE handed in another list of shipwrecks (47 vessels in 30 years) connected with the port, which be said might have been saved if there had existed such a harbour of refuge as it was now proposed to form. He might also be allowed to observe that as a notary he had captains continually coming to him to extend their protests.

The COMMISSIONER asked if there was not an agreement between the Canal Company and the Lancaster and Carlisle Railway Company, for transferring the Lancaster and Preston Railway to the latter.

Mr. J. HIGGIN said there was something of the kind, but that did not affect the present question. The Lancaster and Preston Railway was yet in the hands of the Canal Company, and they must protect their own interests. He had felt from the earliest portion of this inquiry, that it extended to the obstructions of the river Lune, and now it was conceded, as its basis, that the projectors of the dock in Heysham were doing injury to the Lune. According to Mr. Sharpe's scheme, he was going to create another nuisance by putting weirs across the Lune, and also to divert the water by making a ship canal to Poultry Ring. It was evident from this statement, that the flow of the tide would be obstructed, and he denied that there was any authority now existing to justify such obstructions in the river Lune. It was the duty of the Commissioners of St. George's Quay to resist such contemplated obstructions by all the means in their power; and he had no doubt the Tidal Commission would not rest satisfied with the loose evidence tendered that day. It was evidence such as might be picked up at the corner of any street, and was only important so far as it might lead to legitimate evidence. He appeared there on behalf of the Canal Company, and so long as the canal was in their hands, it was their bounden duty to protect their interests. He would show them that by an Act of Parliament passed in 1793, the Canal Company were empowered to make a communication with the dock at Glasson. That communication had been made, and the Canal Company had expended 70,000*l.* on the faith of that Act of Parliament. He thought, therefore, that he was entitled to say, after the expenditure of this large sum, that whatever projects might be carried out to Poulton, they ought to be carried out independently of the river Lune. He would now apply himself to the 10,000*l.* given by the Lancaster and Carlisle Company. That and the other sum were intended to be applied by the Commissioners of St. George's Quay in the improvement of the port, and the limits of the port of Lancaster were described in the Act of Parliament as extending from the Old Bridge to Abbey Skure. The money was to be appropriated to the improvement of the Lune, and could not be legally diverted for the purpose of making a canal from Morecambe Bay. He opposed, on the part of the Canal Company, the application of that sum, or any part of it, to that scheme. In the first place, that project would damage the river Lune; and in the second, the money was devoted to a specific purpose, and could not be fairly applied to any other. They had before them the evidence of gentlemen which, he thought, showed that if the original intention of improving the river were carried out, they would have all that the port required. One part of Mr. Sharpe's scheme was to apply part of the 10,000*l.* in putting it into execution, but be repeated his protest against it. They had been told by several gentlemen who had come forward that the scour of the river was principally occasioned by land-floods; and it must be evident to every one that placing weirs across the river must diminish the force of this scour. There was no authority for expending any part of the 10,000*l.* on that scheme. It might be a most meritorious project, but let it stand on its own merits. He might as well state that the Canal Company had no connexion with the project at Thorn Bush, but be did not mean to say that it might not ultimately be found by them highly advantageous to cut a canal from Glasson Dock to Thorn Bush. The distance would be only a mile; the expense would be comparatively little; and they did not wish to be shut out from availing themselves of this resource, should circumstances render it expedient. Six feet of additional water would also be acquired, and that was a consideration of no little importance. He was not going to trouble them with any lengthened observations. He merely wished to claim from the Tidal Commissioners and that meeting, on behalf of the Lancaster Canal Company, that they should look into this scheme of Mr. Sharpe's a little further, and afterwards report to the Admiralty upon it. The sill at Glasson Dock was so low that a canal could easily be cut. The Thorn Bush scheme was no new one. The York and Lancaster Railway would be connected with Thorn Bush.

Mr. E. SHARPE said Mr. J. Higgin had spoken of the 70,000*l.* laid out at Glasson by the Canal Company, but he had omitted to mention the *quid pro quo* they received. That was given in the reduction of toll upon all goods entering their canal by Glasson Dock.

Major MACLEAN begged leave to remark that the Lancaster and Carlisle Railway Company, in paying the 10,000*l.*, had never had any intercourse or contracted any obligation with the Canal Company, which might lead the latter to suppose that they were to have any voice in the outlay of it. It was left to the Admiralty to dispose of it as they thought fit, and all that was requested was that they should consult the interests of the Lancaster and Carlisle Railway Company by consulting the interests of the town, when they decided in favour either of one project of improving the navigation or the other.

APPENDIX B.

LANCASTER.

No. 159.

Denham, on the River Lune and Morecambe Bay.

No. 159.

Report by Captain H. M. DENHAM, R.N., F.R.S., *on the River Lune and Morecambe Bay.*

LOCAL concern at the languishing state of shipping intercourse with the ancient port of Lancaster. The futile effort to maintain position which Glasson Dock evidences. The fact of a port* having been adopted within three miles of the foot of Lune during the last six years, properly incite, at a period when Railway communication is forming with the east, as well as the north and south, from Lancaster, the general and widely spreading questions—What are the hopes of uninterrupted sea-borne intercourse with the west? Can the Lune be rendered less dependant on high-tide periods! Or is there any other course by which Lancaster can be brought into packet and shipping intercourse at low-tide periods?

In disposing of the first query, the mind's eye must be thrown outside the mainland confines of the Lune estuary, and there contemplate the utter hopelessness of a bar of four miles depth, with its surface actually on a level with the sea-level at low-water ordinary spring-tides! A space down which the outfall of freshes and tidal drainage can produce no permanent course or friction service, nor maintain any dredging process, seeing that the flood and ebb set of tide of the bay range obliquely over the sea-reach or outfall alluded to. It is true that tide diverting weirs may be planted, and dredging operations applied *within* Sunderland Point to the effect of straightening and deepening the present tortuous and variable course of the Lune down from the quays to Sunderland Hole, thereby rendering the ascent easier; for at present it is not only circuitous and forked, but the bed of the river inclines from the bridge to Sunderland 18 feet, affording but 10 feet over Scale Ford at high-water ordinary springs. Such a process, however, would incur vast expense—would not redeem land commensurately, but would decrease the scour outside the high-water orifice (Sunderland Point and Chapel Point) in proportion as the tidal flow was checked and reflux diminished; so that whilst deepening and straightening the interior of the estuary, its approach would be shallowed; not but the sea-reach or four-mile bar below Sunderland Hole would after six feet silting be as deep as the interior channels still; nothing should be done that would shut the coaster an hour longer out of Sunderland Hole: at present it is lamentable to see a steamer of eight feet draught detained for four hours at a time at the foot of Lune, 12 miles below her quay, exposed to the whole fetch of the Irish Sea. Of course any lighting and buoying facility will mitigate the casualties of night-fall periods;† but nothing than a deeper and more permanent access than exists can confer upon the port that navigable celerity which its daily increasing commercal resources and facility with the interior demand! Can access to its railway branches, or terra firma, be attained at *low-water periods by the Lune* at any definable expense, or by any plan short of embanking all Sunderland shoulder and Cockerham Sands? The particular plan of the region which accompanies this, will say to the distant inquirer—No! to which local knowledge must, however reluctantly, respond, hopeless indeed is the Lune's access!

How, then, can such a boon, so essential an element to a port's existence, as low-water communication, be attained?

The plan of the whole bay, which also accompanies this, at once meets the question. It is only necessary to direct the eye of those of local knowledge and within reach, or the mind of those at a distance, to the leading feature and tidal capacity. We perceive, then, that whilst the promontory of Heysham, and its four mile tongue of sand, Sunderland Shoulder, divides the Lune from the Great Bay Channels, and is only accessible on the Lune side, between half-flood and half-ebb, yet, on the north, or bay side, a steep-to portion of the strand may be approached direct from the Irish Sea at all hours of tide, without any sub-marine operations, but by merely lighting and buoying the spits and margins which form the approach. The steep-to position alluded to is called "Old Scare," a layer of marl covered with boulders stretching into the New Grange Channel from the main land elbow, whereon stands the Old Mill tower, the region known as Poulton Ring. This position possesses 27 and 12 feet water at low-water, is covered from the fetch of sea from the westward by the "Knot-end Scare" and Clarke's Wharf-bank, is approachable from Lune deep by an ample channel space, with not less than 12 feet at low-water, the Yeoman's Wharf covering its roadstead to the northward, affords 16 feet draught at high-water on a layer of sand at its eastern or lee-side, which by excavation would easily and speedily present an ample basin for ships, to cover which, and afford landing accommodation, a pier is only wanting; whilst the contiguous shore and material is perfectly adapted to dock and warehouse project, whether on an extensive scale, or progressive works to form an eventual whole; which work may be most easily, to every engineering point of view, connected with Lancaster by a three-mile railway, and perhaps a canal communicating with the Lune abreast of "Salt Ayre." Thus effecting a landing at all hours of tide, night and day, at a spot only three miles from Lancaster, instead of coasters lying at the north-west buoy, at foot of Lune, for six hours at a time, 12 miles off, exposed to the whole fetch of the Irish Sea, where indeed if a voyager of more than 14 feet draught, vessels have to ride it out for a quarter of a moon; whilst from abreast of which it is only an hour's run to the position which invites a landing or anchorage or basin within three miles of Lancaster at Poulton Ring. The course to which lies fairly from off the foot of Wyre Light up the Lune, deep into the New Grange Channel, between Clarke's Wharf and Yeoman's Wharf, a channel with good working space, straight, and presenting but one shallow (a muscle-bed, called "Low Scare," with 12 feet past it, but could be dredged up in a month), otherwise it may be called an 18-feet channel at low-water, and requires nothing more for night access than a floating light‡ at the extremity of Clarke's Wharf, with a couple of leading§ pier lights at Poulton, whilst, for thick weather by day, three red buoys on the north-east margin of Clarke's Wharf, and three black buoys on the south-west margin of "Yeoman," would denote the gangway, so that a man *once* navigating it would be ever at home to it. And the stranger is provided in his exigency if forced into the bay, whether bound to

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* Fleetwood.

† Three or more *red* buoys along the south-west margin of Sunderland Shoulder, as shown upon plan in pencil; and two leading lights; one where the present Mariner's Perch (Abbey Scare), which can be a *frame*-work with lantern elevated 10 feet above high-water level; the other, a White martello tower, with lantern elevated 20 feet above high-water level, and sited at the road end on coast-line, between Abbey Point and Chapel Point, as shown on plan in pencil. Both lights to be red, and only lighted from half-flood to half-ebb.

‡ One masted vessel moored as shown on plan (in pencil), with a *red* light, so as to avert confusion with Foot of Wyre Light.

§ Both *white* lights; one on pier head, elevated 10 feet above H. W. level, with tower *red*; the other on Stone Scare, 30 feet altitude, and white on outside; or a tower with lantern elevated 40 feet on cliff, as shown on plan in pencil.

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the New Harbour of Poulton or not, by taking advantage of that anchorage to be henceforth known as "Lancaster Sound," and dedicated to the mariner in my sailing directions in the following words:—

"But should you not require to enter either of the resorts for traders in Morecambe Bay, but have overshot Liverpool, or fallen short of your advance to the northward on a stormy night from the westward, and cannot face it, until a change of weather to regain your ground, therefore only desirous of a tolerable anchorage (independent of tide or dues), proceed up Lune Deep until foot of Wyre Lighthouse and Fleetwood Mount come in one (bearing S. ¾ W.) when, by hauling northward upon that transit, you will, in a mile run, find yourself under the lee of an underwater breakwater (the Fisher-bank patches), that stretch three miles on a north-east and south-west trend, the centre third of which lies two miles north of Wyre Light, and come awash at low-water springs. This anchorage or clear space presents an area of two miles by one on the south-eastern and sheltered side of the patches, with seven fathoms water, and clean stiff-holding ground. This hitherto unnoticed space is now called 'Lancaster Sound' on my chart. Fleetwood Tide Lights in one, and Walney Light bearing N.N.W. ¼ W., guide to the anchorage at night."

The following extract has likewise been submitted to the Admiralty, with my survey:—

"It should be understood that Morecambe Bay, within Lancaster Sound, the which is only accessible on the southern or Lune Beep side, is a mass of banks and spits, giving feature to the remains of the 'Old Grange Channel,' 'Heysham Lake,' and the only important arm of tidal water (which is bounded by Clarke's Wharf on the south, and Yeoman's Bank on the north), called 'New Grange Channel,' extending seven miles laterally with Heysham Lake to Poulton Ring, carrying 15 and 20 feet water at low-water, to a point just below Poulton-le-Sands (the channel having no obstruction but a muscle scare, easily removed), where good capacity exists for the formation of breast-works, piers and docks, approachable at low-water, and by overland transit of three miles, restore to Lancaster its wonted sea-traffic, independent of its hopeless sea-reach of Lune. But as neither light, beacon, buoy, or perch guides the way within those spits at present, the chart can alone impress the feature; no written directions can pretend to impart it."

It may be reasonably hoped that much additional importance will be thrown upon Lancaster Sound by any energetic efforts to restore, may we not say, *exceed* any former shipping intercourse with the port of Lancaster as will give it place in the Commission of *Refuge Harbours*, for it is obvious what additional security might be afforded if a substructure, such as the Fisher-bank Patches present, was availed of. As it is, when promulgated, it will prove a vast boon; for, though troubled water is experienced at high-water periods; yet, as the underfetch is arrested, the ground-tackle of a ship is eased. At all events a joint effort and appropriation of funds of all the interests of the bay should be directed to the buoying off the south-west extremity of it, if not putting a floating-light there,* raise it above high-water, and it will be to Fleetwood and Lancaster what Plymouth Sound is to Catwater and Hamoaze.

It will be no small incentive to weigh well the importance of such a tidal capacity as Poulton Ring presents; and as the bay now remains, is likely to preserve for an age for giving effect to the grand centralizing of railroads now forming at Lancaster by grasping at this maritime link. Hesitation or supineness may bring about a project for enclosing the bay; and though such would not be permitted of the harbour enterprize was advanced, yet the first in the field is always forearmed and can dispute reasonably the ground.

In presenting this Report, I refrain from *specific* plans and *details*.† I have delineated the existing feature of the region, and it is the only actual survey extant. In printing the outline of what may be done, the motives for, and locality of, the works, and so the latter is respected, I think it better to leave the engineer to make the best of its capabilities, with reference to the means, too, that may be embarked at once, or from time to time: the early consummation of which cannot be too promptly and vigorously supported and advanced.

H. M. DENHAM.

APPENDIX B.

LANCASTER.

No. 160.

Stevenson on the Improvement of the Lune.

No. 160.

On the Improvement of the Port of Lancaster. MESSRS. ROBERT STEVENSON and SONS, *Civil Engineers.*

Edinburgh, 30th September, 1845.

HAVING been consulted in 1839 by the Quay Commissioners of Lancaster, as to the best means of improving the Navigation of the Lune, we made a survey of that river from Lancaster to Glasson, and reported that its navigation might be deepened to 16 feet at high water of ordinary spring-tides, for an expenditure of 13,000*l.*, and that we had no doubt of being able to obtain a depth of 18 or 20 feet up to Lancaster, at a comparatively small additional outlay.

Since that Report was made, our experience of what has been effected on other rivers, by the application of the means of improvement proposed, confirms us in that opinion, which we accordingly again expressed in evidence before the Royal Tidal Harbour Commission, at their examination in the course of the current year.

Our original Report, however, relative to the Navigation of the Lune, and the opinion we expressed to the Tidal Harbour Commission, had reference to the improvement of the tidal channel of that river for the accommodation of the local trade of the district, which is not of sufficient importance to warrant the expenditure of a large amount of capital; and if this were the sole object to be attained, we have no hesitation in saying, that the improvement of the navigation in the manner proposed is the course, which under all circumstances we consider best suited to answer that purpose. It must, however, be kept in view, that such means of improvement could never render Lancaster accessible at all times of tide, and as the various present and projected lines of railway, which converge to it are to add greatly to the traffic of the port, it has become a matter worthy of attentive consideration, in what

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* A vessel with 2 *horizontal white* lights 15 feet above water line, and 2 red flags by day, moored as shown on plan in pencil: to lead also up first part of Grange Channel.

† Site and idea of capabilities, sketched in pencil.

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manner the increased trade may be most effectually provided for, so as to combine the advantages of ample accommodation for shipping, and low water communication of steam-boat and passenger traffic.

We have carefully considered the elaborate survey of Morecambe Bay by Captain Denham, and the Report of that gentleman, suggesting the establishment of a harbour at Poulton Ring, with railway or canal communication to Lancaster, and having been called upon to report our opinion on this subject, we beg leave to submit the following remarks:—

On inspecting the charts of the Great Bay of Lancashire, including within its limits the estuaries of the Dee, Mersey, Ribble, Wyre, Lune, and other streams discharging into it, it will be observed, that all of these are to some extent encumbered with sand-banks, which render the access to them more or less difficult. It appears, however, from Captain Denham's survey, that the Grange Channel, which extends into Morecambe Bay, not only possesses very ample breadth and depth, but that it approaches close to the shore at the Old Mill of Poulton, where there is a depth of no less than 25 feet at low water, and maintains its character as a broad and deep low-water channel for nearly 2 miles further up the bay. It further appears, that Heysham is only about 2¼ miles from Lancaster, and that the intervening country is most favourable for the formation of a railway or canal communication. On the 16th instant, Mr. David Stevenson inspected the shore at Poulton, and the intervening country in company with Mr. Sharpe of Lancaster, and since then we have given the subject careful consideration.

The situation suggested by Captain Denham for the establishment of the proposed harbour appears to us to be well selected, insofar as regards the formation of the beach and the proximity of deep water. The beach at the point alluded to consists of a hard scare, which is elevated some feet above the adjoining banks on either side. This scare extends to low-water mark, and a few yards off it there is a depth of 12 feet at low-water of spring-tides. The distance from the high to the low-water mark is however considerable, and involves the construction of a pier about three-quarters of a mile in length.

We have been unable in the short time that has been afforded, and with the limited data in our possession, to do more than form a rough outline of the works which would be necessary for the establishment of a harbour in this situation. These (subject to such modification as may appear upon further consideration to be expedient) we believe to be—

1st. A south pier, having its extremity founded in 12 feet at low water, so as to admit of steamers and vessels approaching it at all times of tide, marked *a b* on the accompanying sketch.

2nd. A bulwark and roadway on pile-work, extending over the beach from the low-water pier to to high-water mark, marked *b c*.

3rd. A northern covering bulwark, *g g*.

4th. In the first instance a single dock, *d*, having an area of 6½ acres, the sill to be laid at the level of low water, and a channel e *e*, to be excavated from the low-water pier to the dock-gates.

We have estimated, as nearly as our present information enables us to do, those various works which we think could be executed for a sum not exceeding 220,000*l*.

The accommodation offered by these means would, we think, be ample, as a low-water communication would be at all times afforded, and vessels wishing to enter the docks could come into the shelter of the pier at any period of tide, and wait until there was sufficient flood to enable them to haul into dock.

In looking into old charts, in particular that of Murdoch Mackenzie, we find that the Grange Channel, of which it is proposed to take advantage, maintained its character as a broad and deep low-water channel 70 years ago, which is an encouragement to expect that it will continue in its present state so long as the back water of Morecambe Bay, to which it owes its existence, is preserved.

It must, however, be observed, that the projection of the proposed works for three-quarters of a mile from the shore, will to a certain extent distort the currents; and it seems to us to be a matter for careful consideration, in how far any change so produced may, in the situation alluded to, affect the depth or direction of the Grange Channel. To form a decided opinion on this matter would, however, occupy a greater length of time, and render necessary more minute personal examination of the whole tidal phenomena and currents of the bay than we have hitherto had an opportunity of bestowing.

(Signed) ROBERT STEVENSON and SONS.

FLEETWOOD.

River Wyre.

No. 161.

Evidence taken on the 14th Oct., 1845.

No. 161.

PORT OF FLEETWOOD.—RIVER WYRE.

Examining Commissioners :—R. GODSON, Esq., Q.C., M.P., and Capt. WASHINGTON, R.N.
Present—Mr. KEMP, Mr. BIDDER, C.E., Captain MCNEILAGE, Mr. BAZETT JONES, Captain HEAD, Mr. S. BURRIDGE, &c.

Mr. H. BAZETT JONES, examined.—I am Secretary of the Preston and Wyre Railway, Harbour, and Dock Company, which is constituted under Act of Parliament, 5th Wm. 4th, 1835, and 7th Wm. 4th, 1837. The harbour is governed by nine directors, four of whom go out by rotation every half-year, and are elected by the proprietors. The harbour-master and engineer are appointed by the directors, and make a monthly report to them. The accounts are made up and printed every half-year. The debt on the harbour is 98,745*l*., on which 5 per cent is paid. The harbour, light, and wharfage dues for the half-year amount to 320*l*.; the expenses against this are 331*l*. 16*s*. No complaints had been made to him from captains of vessels, pilots, or other persons making use of the harbour, nor suggestions as to improvements. The directors meet once a month; three form a quorum. Three of the directors are ship-owners, and the attendance is regular.*

Mr. S. BURRIDGE, jun., (receiver of the harbour and light dues,) said,—I have a statement of the harbour and light dues received each half-year from the first day they were collected :—

	Lights.			Harbour.		
	£	*s.*	*d.*	£.	*s.*	*d.*
1835	—	—	—	36	2	0
1840	117	2	6	174	9	9
1842	34	10	10	—	—	—
1845	107	14	1	420	15	4

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* The whole sum expended on harbour improvements is 113,238*l*.

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The dues are collected by authority of an Act of parliament, and the reason they were so large at first was that steamers were plying to Belfast and Ardrossan, and there was considerable coasting trade, bringing materials for the erection of the works then in progress, which fell off in '42 and '43. The Walney light was a great tax on vessels coming here, they being charged 3*d.* per ton per year, commencing on the 1st of January in each year, so that if a vessel came here on the 28th December it is charged for the year just closing, and on going out on the 1st of January would have to pay again. That was not the case with other lights: at whatever time of the year a vessel was charged for, it was exempt for a twelvemonth.

Captain HEAD said—I have been harbour-master at this port since April last, and am a sailor by profession. Have been at sea 34 years, in almost every trade. Have directions from the board to superintend the buoys, beacons, dredge, and the general improvements in the harbour. It is also my duty to berth the ships. Have a complaint from Capt. Wilson, of the steam ship "Her Majesty," of a dangerous bank lying north-west about 2½ miles from the Wyre lighthouse. It is called "Dangerous Shoal," and wants a buoy or beacon upon it. It is within the jurisdiction of the Lancaster Quay Commissioners, to whom I made application about two months ago. I saw the harbour-master, Mr. Walker, personally, who stated that they had more important business in hand just now, but would consider the application as soon as they were more at liberty. All I wanted was to have liberty to put a buoy there, and suggested it was to their advantage.

The COMMISSIONER suggested that Capt. Head should make a formal application, keep a copy of it, and if unsuccessful, write to the Tidal Harbours Commission.

WITNESS never knew a ship break from her moorings in the harbour; they float at half-tide alongside the quay. Five steamers belong to the port, four of which are from 300 to 400 tons register each. The largest ship now in port is 606 tons register burthen, which draws 18 feet water, and can come into the harbour at half-flood, and if necessary along side the quay. Mooring posts, rings, and cranes, are supplied on the wharf, and we shall have 16 cranes on the wharf very soon.

The dredge is of 20 horse power, length of ladder 47 feet, and will work in 12 feet water. The dredge brings up in 6 days 2,380 tons, and in fine weather will lift 400 tons per day. Generally work 14 pontoons but have 30, all of which are sometimes used. The cost of lifting and depositing the soil is about 10*d.* per ton.

The shoal called the Canshe has not increased. There is a fair passage to the quay and room for a steamer to turn. The tide flows about seven miles up the river above Fleetwood, and there are no weirs or dams within the limits of the tide. Can keep the channel free and improve it with one dredge; the average expense of the dredging machine is about 200*l.* per month.

Much shingle has been deposited below high-water mark on the west side of the railway embankment. It does not wash back into the harbour.

Have been here too short a time to say whether the trade had increased. The tonnage of the vessels that have arrived during the last six months is as follows:—Foreign, 3,929; Coasting, 7,068; steamers, 84,605. Harbour dues are charged at the following rates:—Coasters, 1*d* per ton; Foreign vessels 3*d.* per ton; Light dues, 3*d.* per ton. The dues are much less than at the neighbouring ports.

The three pilots belonging to the port are licensed by the Commissioners of Trinity House, first being duly examined. The pilots are sufficient for the traffic of the port. Heard no complaints.

There are no complaints as to buoys, beacons, or approaches to the port. An additional beacon is in course of erection on the outer point of the King's Scar Shoal, the Red Buoy not being sufficiently conspicuous. The Rossall Landmark is about to fall down; it concerns all the ports in the bay as much as Fleetwood.

Mr. KEMP.—The Landmark is leased at a nominal rent to the St. George's Quay Commissioners, at Lancaster. The owners have applied to Sir Hesketh Fleetwood to rebuild it in an improved form in another situation, and Sir Hesketh has given them the terms on which he will grant them a perpetual lease.

The COMMISSIONERS stated, that the Lancaster people considered the terms amounted to a prohibition; that it would cost their port 300*l.* a-year.

Mr. KEMP did not think so. The terms were that the tonnage should be calculated once in seven years, and 1*d.* per ton be paid on the average once in that period, as a fine to Sir Hesketh Fleetwood. They can re-erect and keep it up 21 years under their present lease.

The COMMISSIONERS thought it a great pity it could not be arranged, as it concerned the port of Fleetwood as much as Lancaster.

Mr. KEMP.—The Port of Fleetwood erected their own lighthouses and the Lancaster people pay nothing for them.

Captain HEAD.—When the new beacon on King's Scar is completed, the Rossall Landmark will be of no service to Fleetwood. The want of floating docks is very much felt here. As harbour-master, and a sailor, I think, if docks are made on this side of the river the expense would be greater, but would be as good for the accommodation of the shipping. They would be more out of the tide-way here, and that would be an advantage. If built on this side I think a tidal basin would not be necessary, but on the other it would. There is a small gridiron here for the repairs of vessels, but think a graving dock is wanted. Have heard of a proposition by Captain Denham, to make Morecambe Bay a harbour of refuge. I should think if a harbour of refuge is to be formed, that Douglas Bay, in the Isle of Man, would be the best. Great Ormeshead would be objectionable, because vessels could not get out at all during north or north-west winds. Douglas Bay would be better than any part of the coast of Ireland. Had often talked the subject over with pilots in Liverpool and they were of the same opinion.

Mr. BINDER said—I have been resident engineer of the Port since 1839; since which period the channel had been improved by dredging. When he came, there were no wharfs, neither was the railway completed. Since then an iron and a short stone wharf were first erected, and subsequently a wooden one, making a total length of wharfage of 1,000 feet. Have sufficient mooring posts and rings, and will have 16 cranes when those now making are completed, 13 of which will be available for shipping at the wharf. Greater facilities are given for shipping than by any other wharf in England. The railway runs alongside on the wharf, and goods are taken out of the vessels and placed at once into the railway waggons. The foundation of the wharf is gravel, and 52 feet is the greatest length of any pile. At high water springs the top of the wharf is 4 feet 9 inches above the water. The wharf is well lighted with rose lights and common gas lamps. It is intended to dredge until 10 feet at low water spring tides is obtained from the foot of Wyre Lighthouse to the wharf, 200 feet wide

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in the narrowest part, which he hoped to accomplish by next summer. Have two steamers adapted as tugs. There is now five feet at low water springs. There is great want of dock accommodation, and it is proposed to construct one of nine acres, to be placed somewhere within the port. Thought the foundation on this side was not good and that it would be difficult to keep open the entrance. Have no means of repairing ships at present proposed. Ballast is sometimes supplied from pontoons, the charge for which is 8*d.* per ton put on board. We make no difference between foreign and English vessels. A tide guage is kept at the foot of Wyre Lighthouse which is registered by the light-keepers. This lighthouse was opened in 1840, and the foundation is perfectly safe. The light is a very great advantage to sailors in the bay. The whole of the timber used at the wharf has undergone Payne's process. Steam coal can be procured here in abundance at 8*s.* 6*d.* and 9*s.* per ton. There is no chart of the port in the possession of the directors, and no admiralty agent here.

ROBERT GERRARD examined.—Has been a pilot 20 years and has a license both for this port and Lancaster. Considered the "Dangerous shoal," the most dangerous point in the bay; the nearest buoy to it is Red Buoy, bearing north about 2½ miles. There is not the least difficulty in bringing ships into the Port of Fleetwood. The rate of tide at the foot of Wyre is two knots; after half flood one and a half. The depth of channel at low water springs is about 5 feet; the nature of the bottom is shingle; believed if dredged to 10 feet it would hold safe. There is good anchorage off the foot of Wyre light. Within the last 20 years many wrecks have taken place in the bay, but not within the last three years. Wrecks have generally occurred in the "Foul Ground," where a buoy or beacon is wanted, three or four miles from the north-west buoy of Lune, towards Walney. The Wyre light has been a great saving to vessels. Vessels drawing 15 feet can come into Fleetwood 1½ hours before they can get into Liverpool. Do not think the Lune can be improved by dredging; the channel shifts so much that we have to move the buoys two or three times a year. There are sufficient pilots. Vessels have often to remain at anchor eight days near the foot of Wyre before they can get up to Glasson Dock, and in some cases have had to lighten themselves by throwing over deck loads. That is never the case with Fleetwood; there is not the least difficulty in taking the harbour either by night or day. I think the buoys and beacons are large enough in coming into Fleetwood, but it would be better to have one or two more in Lune. The Wyre light is very advantageous to vessels proceeding to Glasson as well as to Fleetwood.

Captain A. M'NEILAGE, examined.—I have been acquainted with the Port of Fleetwood two years and a half, and have been trading on the coast generally for 20 years. I now command the "Prince of Wales" steamer, trading between here and Belfast, tonnage 312 tons, and draws 9 feet water. There is no difficulty in taking the Port of Fleetwood either by night or by day. Can come up to the quay at low water neap tides, and sail at five hours ebb. The lights and beacons are sufficient and good. The dues on steamers at Fleetwood are only one-seventh as heavy as at Belfast. The charges at Belfast are very high, and there is no accommodation for them. There are greater facilities for discharging here than at Belfast; at the latter there are three or four steamers at one berth, whilst at the former there is always a quay berth. I think if docks were here trade would grow as fast as accommodation is provided, which I have always found to be the case, of which Glasgow is an instance. Think a harbour of refuge most wanted in Douglas Bay. Fleetwood is a place of very easy access by day or night, in thick or clear weather, and even in a fog the lead will bring you to in safety; a bell is used in foggy weather at the Wyre light. Consider the Wyre light the best he ever saw, and the Walney light the worst. Think the beacon now erecting on King's Scar will be a great benefit; even to-day we could see the machine used in constructing it before the landmark was visible.

Mr. KEMP examined.—The company was formed in 1835, but nothing was done to improve the harbour until 1838. Vessels were always able to lay in Canshe hole, and come in at half tide. Since then the channel had been deepened two feet, projecting angles cut off, and generally improved. The wharf was next made and the gravel dredged away so as to have deep water alongside. The cost of the harbour works up to 1842, was 70,000, and the iron wharf cost 21,000*l.*, including the stone at the south end. There used to be six or seven foreign vessels in a year to Wardless with timber and flax. The harbour does not pay of itself but coupled with the railway it does. The railway would not pay without the harbour. The shares are now 25*l.* all paid up, and last half-year, after paying interest on borrowed money, they paid a dividend of 12*s.* 6*d.* per share. The train runs from Preston to Fleetwood in about an hour, and the fares are lower than on any other railway. There are three new lines of railway projected from this port, one direct to Leeds, one to Clitheroe, to join some other line there. These are not projected by the present company, but they purpose extending their own line to Lancaster, so as to join the Lancaster and Carlisle, and North Western lines. Anticipate a great increase of importation from these new lines. Have now a great timber trade from America, and four voyages weekly from Ireland, and the same number from Scotland. Fleetwood at present is under Preston; but a sub-collector and sub-controller have been appointed, with a prospect of being again independent.

No. 162.
Beechey, on the State of the Works.

No. 162.

Captain F. W. BEECHEY, R.N., F.R.S., *on the State of the Works at Fleetwood.*

SIR, *H.M.S. "Lucifer," Fleetwood, 5th August,* 1842.

In reply to your letter of the 16th of June, desiring me to report to their Lordships on the state of the works at Fleetwood, and how far Her Majesty's rights, in virtue of her Duchy of Lancaster, appear to have been infringed, or may become so, by the execution of the works in question, I have the honour to state that these works consist of—

1st. A railroad, partly upon piles and partly upon a stone embankment, from Bourne Naze to Cold Dubbs
2nd. An embankment from the said railroad to East Warren Neps.
3rd. An embankment, or rubble weir, at the foot of the piles of the railroad, to stop the tide passing under it until the water has reached a certain height, to encourage the silting up of the bay within.
4th. An iron wharf and cattle slip, with the buildings thereon, at the port of Fleetwood.
5th. A lighthouse upon piles, at the entrance of the Wyre Channel.
6th. A wooden jetty, opposite the North Euston Hotel.
7th. An embankment, called the Knott Gulf Embankment, on the Presall side of the river

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8th. A small stone pier and crane, at the end of Albert-street.
9th and 10th. A patent slip, a gridiron, and a temporary wooden wharf near it.

All these works are situated between high and low water, and have been finished.

Those works which are in contemplation consist of—

11th. Docks and wharfage upon an extensive scale.
12th. An embankment, called the Necking's Weir, to stop the tide running through the Necking's swatchway, and turn it down the channel.
13th. The cutting of a channel through the Canehe Bank, or the entire removal of the bank, as may be.
14th. The removal of a shelf of shingle opposite Queen's-terrace.
15th. And the erection of certain buildings in completion of the Town Plan, as shown in the plan.

None of these are yet begun, except the Necking's Weir, of which the foundation only has been partly laid, and the Gas Works, of which a portion only of the yard belonging thereto projects outside the high-water line. With these exceptions, all the works above mentioned, whether finished or contemplated, are or will be situated between high and low-water marks, and, consequently, upon ground over which Her Majesty, in right of her Duchy, claims an interest.

These works are all delineated upon the plan which I have the honour to transmit with this report, and distinguished by various tints according to their present state of progress.

Since the commencement of the works first mentioned, a considerable deposit of silt has taken place in a deep bight or bay, situated between Bourne Naze and Cold Dubbs, and now cut off from the river by the railroad.

This bay, designated on the plan as "Kirk Sear Bay," contains about 560 acres of land, the whole of which has been perceptibly raised or recovered from the sea, the outer part of it especially, since the construction of the railroad and Embankments 2 and 3. The whole of it is at present dry until about 4½ hours flood, on a spring-tide, when the water begins to flow over the weir (3), and spreads until the whole surface is covered at the top of the tide.

Before the construction of the railroad the bed of the river passed over the line at present occupied by the piles; but it now lies altogether to the eastward, or on the outside of it. The limits of the bay are defined on the west and south sides by embankments of long standing and by East Warren Neps; on the north side by Embankment 2, which now separates it from Cold Dubbs, and the high-water line of Fleetwood, its original boundary; and on the east by the railroad.

This bay would be a valuable acquisition if it were silted up a little more, and the sea were banked out; and there does not appear to be any reason, as regards the port of Fleetwood, or the river, why it should not be so enclosed whenever the proprietors may think it advisable to have it so.

Its enclosure can have no effect whatever on the river above; and, as regards the port and channel of Fleetwood, the backwater derived from it is efficacious only at times when the stream is already inconveniently strong, and passes away through the Necking's swatchway, without in any way benefiting the channel below, where alone it could be required.

If the backwater could be pent up in this bay until after half-tide, and then let loose as a scouring force, it would be useful so long as the volume remained of sufficient consequence; but it is clear that, by this process, the bay would very soon become silted up, except in the narrow channels leading to the sluices, and thus its utility would be eventually lost. The fact is, that a little before the time, when this bay begins to cover, the sands in other parts of the river begin to be extensively flooded, and the water finds a wide expanse to flow over; whilst the channel about the steep breast and entrance of the anchorage, through which it flows, remains nearly of the same dimensions, so that the stream there consequently becomes inconveniently strong. On the ebb the same inconvenience occurs again without benefiting the port or the channel, in which the tide is now slack, until about half-tide, before which time the bay has parted with all its water, and can in no way contribute to strengthen the tides below.

If the Necking's Weir (No. 12) were carried to nearly high-water mark, and continued to the Great Ford, the first part of the ebb would produce a powerful scouring action on the channel below the Knott, and the backwater of the bay would then, of course, contribute its mite to the same purpose; but, if ever this be done, the backwater of the bay will become rather a nuisance than otherwise, for it will be available, principally, at the springs during the two first hours of ebb only, at which time the tide in the channel along the weir will be inconveniently strong; so that, in any case, I am of opinion, that the "Kirk Sear Bay" may be enclosed at any time without detriment to the port.

Besides, in the above mentioned bay, a deposit or partial increase has taken place in Cold Dubbs and in the Knott Gulf, occasioned by the embankments No. 2 and No. 7; but, with the exception of these three places, there does not appear to have been any perceptible natural alteration in the bed of the river, since the commencement of the works in 1836, worthy of particular mention.

I come now, Sir, to that portion of the Warren of Fleetwood, on which the town is built. There appears to have been no natural increase of land here, or perceptible alteration in the high-water line, except on the south and east; in which direction the railroad terminus, with its branch-rails leading to an iron pier, and the iron pier itself, with its cattle slip, have been erected, and nearly the whole of which stand upon ground which, before the passing of the Railroad Bill, was covered by the sea at spring-tides, and by their erection has been clearly recovered from the sea.

There can be very little doubt, at present, as to what portions of these buildings are situated between high and low-water marks; but every day's delay must increase the difficulty of accurately defining such limits.

Of the works in *contemplation*, the whole of the docks and eventual wharfage, and the wharf at Cold Dubbs, will be erected upon ground which is at present daily covered by the tide, and a portion of which has been raised by deposit of sand and silt; but the increase is here so small, that, without taking evidence, it would be difficult to get at the fact.

I have now, Sir, reported upon all the works which have been executed, or are in contemplation, by the Company, and would suggest that a competent land surveyor be sent down to Fleetwood to define accurately the high-water line, and to measure carefully from thence to all the buildings or works upon which the Duchy has any claim; and that, wherever the right of Duchy is doubtful, or it may depend upon a perceptible recovery from the sea, stakes be driven in, and other means be taken to determine any alteration that may take place hereafter. This will be essentially necessary about the site of the proposed docks, wharfs, and eventual wharfage, graving dock, &c., the alteration there being more a matter of *opinion* than apparent from fact.

The land about the Knott Gulf embankment also should be similarly defined, for it may eventually become the site of a quay or other works for the reception of goods intended for the Presall side of the river and Lancaster.

The land on the north side of the town, about the intended site of the Necking's Weir, should also be defined. Opposite Queen's-terrace, also, there will probably be eventually erected jetties or quays, which will become valuable as the trade of the port increases. A portion of this beach has been raised partly by hand, and partly by the washings of the tide, since the pier has been finished.

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It does not appear from any information I have been able to collect, that, with the exception of the before-mentioned siltings of the bay and Cold Dubbs, there has been any alteration produced on the banks of the river by the works of Fleetwood, which have been hitherto executed as far as Bourne Naze.

Above Bourne Naze the river becomes much contracted, and still more so about Rawcliffe.

In all this part the bed of the river remains much the same as it was 40 years ago, except that the earthy banks on either side are washing away, and thereby widening the river.

About Means Hall an attempt was made, many years ago, to sward up or reclaim a small portion of the bank of the river by means of stakes driven in, but it failed, there being no deposit of consequence, owing to the freshes and the daily stream of tide carrying it away.

In all this part of the river there are deep bays and indentations in the banks, which rise to within a few feet of high-water spring-tide mark; and many acres might be reclaimed by means of embankments thrown across them, but whether it would be advisable to do so in a pecuniary point of view I cannot say, but should think it would not; whilst, on the other hand, it would certainly be injurious to the port of Fleetwood to deprive it of backwater, which becomes available at a useful period of the tide, and is, at all events, useful in preventing the intermediate parts of the river from silting up.

High up the river, some alteration has occurred since the erection of Cartford Bridge: but that extends to a period far beyond the time to which my inquiry is limited.

In conclusion, Sir, I have to observe that there is no difficulty at present in obtaining evidence of the silting of the bay, of the Cold Dubbs, and other places above mentioned, or of the original high-water limit about Fleetwood; but I beg to suggest the propriety of making the above-mentioned land survey and measurements at an early period, in the event of any law proceedings being contemplated.

I have, &c.,

The Honourable the Secretary of the Admiralty. F. W. BEECHEY, *Captain.*

PRESTON.

River Ribble.

No. 163.

Evidence taken on the 15th Oct., 1845.

No. 163.

PORT OF PRESTON.—RIVER RIBBLE.

Examining Commissioners—R. GODSON, Esq., Q.C. and M.P.; Captain WASHINGTON, R.N. and F.R.S.
Present—The MAYOR of PRESTON, P. HAYDOCK, Esq., Mr. PARK, C.E., Captain RICHARDSON, Mr. BOND, &c.

Mr. P. HAYDOCK—I am chairman of the board of directors of the Ribble Navigation Company, and have been so since the formation of the company. Mr. Pilkington was the secretary at first, but now Mr. E. Haydock, my son, acts in that capacity. We have had two Acts of Parliament; the first in the 46th Geo. III., and the other in the 1st Victoria. There was an old company, but on the formation of the new one we bought up the old one, and gave them four new shares for one of the old ones, and paid off their existing debt. The managing body consists of twelve directors, who are elected by the shareholders. They are elected every two years at the annual meetings. The retiring directors are re-eligible, and have hitherto been re-elected. One half of the directors go out every year, and consequently there is a re-election every year. There have only been three changes, and those by death, since the formation of the company. There have not been any complaints that I am aware of for want of buoys, lights, or on account of sand-banks. There is no question but that a lighthouse is wanted at the entrance of the river, near the landmark called the Double Stanner. There has not been any order issued for such a work to be done; it has only been mentioned in conversation. It is intended to make a wooden pier at Lytham, and for this purpose the contracts have been let. The Double Stanner is about three miles below Lytham, and the nearest light to that is the Fleetwood one. The entrance to the port is at the Nelson buoy, about ten miles out from Lytham. No more buoys or beacons are intended to be placed. We shall have to consult our engineer concerning the lights, and I expect we shall be advised to have two lights. By the Act of Parliament, the grass lands that are reclaimed by our embankments between high and low-water mark will belong to the landowners whose property they may adjoin, and who will have to pay the company a yearly ground-rent for it, the amount of which is to be fixed by a referee.

The COMMISSIONER observed that this clause of the Act showed how very much more readily the Crown parted with lands then than it does now. Three of the Directors are a quorum. Six or seven Directors generally attend the meetings. As regards the accounts, the old trust was in debt. The affair was then in the hands of the several landowners, but the new Company got it into the hands of the merchants. The old Company were in debt about 4000*l.*, and their shares were valued at 8000*l.*, and in consideration of their giving the project up, the new Company agreed to pay the debt, and to give them four shares in the new Company for one in the old. The effect of this was that the Company was now in possession of a considerable revenue. The following will show the increase:—In 1838, the first year of the new Company, the revenue amounted to 501*l.*; in 1841, it had increased to 766*l.*; and last year, 1844, to 1920*l.*; showing a progressive increase of from 200*l.* to 300*l.* a year. We are able to pay a dividend of 10*s.* per share. The expenses have to be deducted from the amount just given. We have made our third dividend of 10*s.* per share. The accounts are published half yearly. We have no actual sailors or sailing-master amongst our Directors, but we have four shipowners. Two of our Directors audit the accounts, with which the shareholders are satisfied. There has been no complaint of the extent of the tolls, which are fixed by Act of Parliament. We have never levied them to the full extent. The tolls we are authorised to collect are 6*d.* at each river line, but ships pay 4*d.* only. A vessel going out does not pay at all. We are going to have a new line of railway from the North Union to the Victoria Quay, for which the Act was obtained last session; this will bring coal down to the river, and the amount of tolls received will probably thus be doubled. We raised 50,000*l.* by shares, and were empowered to borrow a third more, but instead of borrowing, we raised it by shares. Another Act was also obtained to borrow 22,000*l.* more, and this is not yet expended. We pay 4 per cent. With part of the money last raised we intend to build a lighthouse. The salaries paid amount altogether to about 250*l.* The Lily steamer is a loss to the Company. Vessels that are towed up the river pay us 4*d.* per ton. The whole harbour dues are, say for a vessel of seventy tons, 70*s.*, or 1*s.* per ton. The wharfage goes to the corporation as the landowners. They find quays, cranes, and other conveniences. The corporation will put 100,000*l.* in their pockets by their land on the edge of the river being built upon.

The COMMISSIONER.—In Liverpool the dues are laid out in the improvement of the river, but here it appears they go towards the improvement of the streets. The question is whether part should not be applied to the river, or even whether the corporation have a right to raise money by one means, and then apply it for another purpose.

The corporation hold the property as a body. The present quay was purchased by the new Quay Company from the landowners, and when their lease was expired, it was sold to the corporation. The wharfage is only 3*d.* per ton. The harbour dues are 6*d.* on British vessels, and 9*d.* on foreign. The Directors of the Ribble Navigation Company are satisfied that the corporation should have the benefit of the quays. The wharf is about to be extended about 150 yards.

Mr. P. PARK examined.—I have been resident engineer to the company for six years, and assisted Mr. Stevenson in his survey before the Act was obtained. Mr. Brebner was the engineer at first, but the Company were not satisfied with him and I was appointed in his place.

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I have known the river for 20 years, and have surveyed it. When first I became acquainted with it the channel was very tortuous, and changed almost every tide; it was also very shallow. A series of jetties were thrown out on each side of the river by the landowners, to throw the stream from their own property. This was done to an extent of about seven miles. The effect of these was to drive the stream from side to side, and make the channel irregular. These are nearly all taken up. There is always a depth of from two to three feet of river water. Before the improvements, neap tides did not show at Preston, and a 14 feet tide just reached the quay.

(Mr. J. SMITH said that 40 years ago a 14 feet tide showed about an inch, and now vessels could come up to Preston with a tide of that height.)

Mr. Park continued.—The navigation of the river had been considerably obstructed. About half a mile below the Preston quays a band of red sandstone extended across the river, and only a foot of water flowed over it. This was in 1839, and we called in the Messrs. Stevenson of Edinburgh, who said that the rock must be removed; but they did not think that it would be necessary to make rubble embankments down the sides of the river. We excavated the rock by blasting. A coffer-dam was formed round it, and 30,000 cubic yards of stone were taken out. The work cost 11,000*l.* We then got a steam dredge of 14 horses power, which cost 4000*l.* It was built at Preston; the steam-engine and dredging machinery were made at Leith. It began to work in July, 1839, and up to December, 1844, there has been raised by it from the bed of the river 476,955 tons, principally of gravel.

The dredge has 32 buckets about one foot nine inches apart. There are also horns to take up the stones that may be in the bed of the river.

The stuff is lifted and deposited on the banks of the river for five pence halfpenny per ton. In addition to this we have put down eight miles of rubble embankment. Without so doing the channel fills up again almost as soon as it is dredged. Messrs. Stevenson recommended one line of wall, but we have since put a second. We intend to carry them to the Naze. There is only one opening in the north wall, and that is where the Savick runs into the Ribble. The act authorizes us to carry the walls to the Naze, but we are restricted from going any further.

Mr. HAYDOCK read over the act. Sir Hesketh Fleetwood, who then owned a large part of Southport, had strongly opposed them, as it was said that the extension of the river wall would make Southport an inland town instead of a watering place.

The COMMISSIONER.—So the river was to be spoiled for the sake of benefiting another town in future times. He thought it was desirable that they should have power to go further with the walls.

Mr. PARK continued.—Southport is just at the sea line, and about six miles below the foot of the wall. The Naze is four miles from Lytham. We wish to carry the wall on the south side of the channel about a mile and a half below the Naze. The walls are yet incomplete. To commence at Preston on the south side; the wall embankment, for about a mile, rises over high water mark; then there is a mile incomplete; below this the wall stands about eight feet above low water.

To-day with an 18 feet tide the wall on the south side opposite the new quay is not covered, and there is 11 feet of water there. The foundation of the walls is sometimes washed out, but this is examined from time to time and protected by gravel or rubble stones, as required. Lower down about a mile from the Naze the walls are unfinished, and stand from four to six feet high. All this length was covered by to-day's tide. About 1000 acres of land on each side the wall will be reclaimed. It is now all sand, and is covered with a 16 feet tide. It is gradually silting up, and where this is now taking place used to be part of the old channel. It was formerly covered with six feet of water. It will soon become a salt marsh.

The COMMISSIONER.—And then by Act of Parliament it becomes the property of the landowners whose property it adjoins. Mr. HAYDOCK said that they expected there would be a claim by the Duchy.

Mr. PARK.—The silting up will exclude a part of the tidal water which now scours the lower channel. The highest tides go up to Brockholes Bridge, which by the river will be about five miles above Penwortham Bridge. There are no weirs or dams to interfere with the stream, but the rocks at Cuerdale prevent a further rise of the tide. There are several piers of bridges which cross the river in the Ribble.

Mr. HAYDOCK had made a few observations with regard to the tides. On the 13th of October there was a tide of 15 ft. 11 in. at Liverpool, and there was 9 ft. of water up at Preston; and on the 14th, with a tide according to the Liverpool table of 17 ft. 3 in., there was a rise at Preston of 10 ft. 6 in.; and formerly, with a similar tide, only 5 ft. flowed up, thus giving an increase of 5 ft. 6 in. in about six years. On the 14th, a Wexford vessel, drawing 10 ft. 3 in., came up to Preston. The fall from Preston to Lytham in the bed of the river was formerly 14 ft., and this they were now engaged in lowering.

Mr. PARK.—We get free-stone from quarries at Longridge and also by canal from Lancaster. It costs from 2*s.* 3*d.* to 2*s.* 6*d.* per ton to be laid down on the margin of the river, and Mr. Bond places it on the line of wall, and pitches or paves the face. We use clay and gravel for the embankment, with which we are now making the walls water-tight. We do not use concrete on account of the expense, although we have the means of making it. We foot the walls with gravel, and it is found to answer very well. The width between the walls is 100 yards; the space of water between them at low-water is not quite so much. With regard to the difference of time in high-water, it is high tide much sooner than it formerly was; but there is still a difference of nearly 50 minutes between the time of high-water at Lytham and at Preston. If the embankments were carried below the Naze the water would still be very shallow at low tide, perhaps only two or three feet. The tidal line at low-water is below Lytham some distance. There is no tidal water at Lytham at all at low water.

Mr. BOND.—We have six feet water about a mile and a half below Lytham at low tide, which is more than they have in the rock channel at Liverpool. Ships can anchor at No. 5 buoy, at the mouth of the river in 18 feet, and there they may with safety wait a tide. There is a small iron anchor fastened to this buoy, and an anchor is also painted in white, to denote that there is safe anchorage.

Mr. PARK proceeded.—I have here a table showing the increase of the number of vessels arriving at the quays at Preston since the formation of the new Company. I have taken the first three months in each year so as to be able to include the year 1845:—

		Vessels	Tonnage
In the first 3 months of 1840 there arrived—outgoing		0	0
Ditto	1841	23	1408
Ditto	1842	37	2307
Ditto	1843	61	3996
Ditto	1844	66	4367
Ditto	1845	95	5805

This is exclusive of lighters, which class of vessels came up to the quays previous to the improvements. The vessels vary in tonnage from 50 to 100 tons. The whole amount of the cost of the improvements up to June 30th, 1845, is 45,000*l.* It appeared that 12,082*l.* had been paid to the old Company for their debt and shares. 6654*l.* had been expended in law and engineering expenses.

Mr. HAYDOCK explained that this item included the cost for obtaining all their Acts of Parliament, in which they had met with the strongest opposition from Sir Hesketh Fleetwood. Mr. Stevenson also had been paid 7*l.* 7*s.* a day.

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Evidence taken on the 15th Oct., 1845.

The next item is 7946*l.* for the steam dredge and punts. The total cost, however, appears to be 45,000*l.* One result is, that we have persons to fix the value of the land reclaimed at first, but when it is improved, the rent is not to be increased, and then there is this singular clause, that it may be decreased

Capt. ASHBURN, the harbour master.—I have been acquainted with the port for 23 years: have been harbour master 11½ years. I perfectly agree with all that the engineer has stated. When first I knew the river the depth of water up at Preston with a 19 feet tide was 6 feet, and vessels drawing 6 feet could only come up for the two or three days when the springs were at the height, and now vessels drawing 11½ feet come to the same spot. The Lily steamer draws 5 feet, and can come up 10 days out of the 14. When she is not on the river she is either employed in towing vessels out to sea, or else she lies in the Lytham dock. The dock at Lytham is a tidal basin, and will hold 30 vessels, coasters. The size that usually come are about 100 tons, Irish traders chiefly. The largest that has come in is a barque of 375 tons, laden with timber. A wooden pier of 170 yards in length is about to be erected at Lytham, the timber for it is now undergoing the process of Payneizing at Fleetwood. The dock at Lytham was made three years ago. We are short of quay room at Preston. It rests with the corporation to provide better accommodation for vessels as far as quays are concerned. There are no symptoms of anything of the sort being done at present. There are two cranes on the wharf, one fixed, the other moveable, and a third is ordered. The fixed one is 7 tons, and the moveable one 1 ton. There are plenty of mooring posts. There are no complaints of ships breaking the posts, but they sometimes break their cables. A chain was broken this week. During a fresh, the water in the river runs at the rate of about 7 knots an hour. We have 12 feet of fresh water in the river at times. A large quantity of deposit comes down with the freshes, and I think is deposited near the bar. Large trees have been taken from the bed of the river whilst dredging, one of 13 feet in circumference, and about 40 feet long: the horns of animals and human skulls have also been found. The perches on the walls are about 152 yards apart. There is one buoy and one perch between the Naze and Lytham. The channel below Lytham shifts about, and we have to move the buoys occasionally. From Lytham to the sea there are 8 buoys and 1 perch in the north channel. They are numbered from the sea, No. 1 to 8 and have the letter N upon them. No. 1 lays in 5 fathoms at low water. Outside this there is the Nelson buoy, a nun buoy, 21 feet long by 9 feet in diameter, with an iron mast through it, with a cage on the top: it cost 105*l.* It stands 24 feet out the water; and was made by Mr. Thomas Woods, of Lytham, who has also made one for the Admiralty of a similar size, which is placed somewhere on the south coast of England. In our south channel we have also 8 buoys; they are carr buoys, and have the letter S upon them to distinguish them from those in the other channel. The north channel is the most frequented. A ship could come to the bar at low water, but no further. There is one light at Lytham, which is only lighted occasionally. There is another landmark not far distant, which can be seen at 10 miles' distance. There should be leading lights to Lytham, and one of them to be moveable. The Trinity Board or the Ribble Navigation Company should do it. One should be lighted all night, and the other at tide time. The increase in the traffic of the port quite warrants the expense of this. Fleetwood is the nearest lighthouse, and that is 14 miles distant; Formby light-ship is the nearest on the south side, and these would not be interfered with by the proposed lighthouses. The perches on the walls should be more conspicuous; they consist of poles, at the head of which a barrel or pieces of cross board are placed, but many of these are destroyed by parties shooting at them. The number of arrivals average about 60 a month. I have known 96 vessels come up the Ribble in a month. I have known a 25 feet tide in the Ribble. A S.S.W. wind is the best for bringing up the tide. I have seen at Preston one day only 3 inches of tidal water, and the next day 8 feet 3 inches.

Mr. HAYDOCK.—With regard to railways there is a branch in course of formation from the North Union Railway down to the quays. There is also a report of one from the Wyre Station at the Maudlands to the quay, and there is another in course of formation down to the dock at Lytham. The Liverpool, Ormskirk and Preston Railway will, if the original plan be carried out, cross the Ribble a short distance above the quay. It will not interfere with our works, and I do not know whether the placing of more piles for bridges in the river will injure the navigation or not.

The COMMISSIONER said that by an Act which had just been obtained, no railway or other company could build a bridge over any tidal river without first gaining the permission of the Admiralty.

Captain RICHARDSON examined.—I have known the port of Preston for 25 years, and command the Cumbria, which trades between the ports on the south-east coast of Ireland and Preston. There is better water at Preston than there is at Wexford. The Cumbria is registered at 63 tons, but carries 100, and draws 10 feet water: formerly she could only come to the Naze. There was no dock at Lytham then. Now she can come up to Preston quays and discharge her cargo there. We generally bring over grain and take back coals. We sometimes lie afloat at the quay, and sometimes not, but the vessel never receives any injury. We can lay afloat at the New quay. There has been a great increase in the traffic on the river in consequence of the improvements which have been made in the navigation. Sometimes we are short of quay room, and then we have to lay in tiers alongside the wharf. I believe that representations of the want of room have been made to the harbour-master. If any vessels break loose from their moorings, it is their own fault. It is now easier to get up the river, although the channel is made narrower. There are not enough of perches on the river walls. I have not known any vessel ever get on the walls or receive any damage. A vessel might easily break her back if she remained across the wall. In coming in from the sea we are short of lights which would be a great benefit. The increase in the traffic warrants the increase of expense in placing lights. The dues are higher coming up to Preston than they are at either Liverpool, Fleetwood, or Glasgow. It used to cost us more to bring our cargo up by lighters than the dues are now. The expense used to be 8*l.*, and now it costs only 3*l.* 3*s.* When we go up to Glasgow, it is very expensive if we are towed all the way. We pay 10*d.* a foot for towing, and 2*d.* a ton for harbour dues on entering, and 1*d.* per ton per week for wharfage.

Mr. BOND.—When the Fame went up to Glasgow, the expense was 16*l.*, she is 81 tons. If she came to Preston the expense including towage is 5*l.* 10*s.*

Captain ASHBURN.—We have no tide scale. There is one down at the chain, but it is useless, and there was one at Lytham for a month or two, but it was given up.

Captain RICHARDSON.—The water over the bar is as good as ever, and the dredging has not injured it. The walls should be carried down two miles below the Naze.

Mr. PARK was of opinion that this could be done without a new act.

Captain RICHARDSON said they would readily pay the extra expense if they might have lights at the mouth of the Ribble. He had been obliged occasionally at night to make for some other port. Peel was a good harbour of refuge, and they could get in there at quarter tide. There had not been many wrecks in this neighbourhood lately. The way up to Glasson was good, but there also was a want of light. From Glasson to Lancaster the navigation was crooked and shallow, but he had no doubt but that it might be improved. He should prefer having a harbour of refuge in Ramsey Bay to anywhere either on the west coast of Lancashire or on the east coast of Ireland. Good charts of this coast are much wanting.

Appendix B.

Preston.
River Ribble.

No. 164.

Stevenson, on Improving the Navigation of the Ribble.

No. 164.

Report of Mr. Stevenson, C.E., *on Improvements in the Ribble.*

Edinburgh, 16*th March*, 1837.

The reporters have severally visited Preston, with a view of inquiring into the best mode of improving the navigation of the Ribble, and have examined the numerous plans and suggestions upon this subject which have been communicated to the corporation by engineers and others. They have also had sections of the river made between the bridge of Penwortham and the village of Lytham, by Mr. Park, surveyor to the corporation; and through the facilities obligingly afforded by Captain Beaufort, hydrographer to the Admiralty, they have had access to the Admiralty survey of the Ribble, which was completed in the course of the year 1836, under the able direction of Captain Belcher, of the Royal Navy. From these data, and from their own observations, they now proceed to report on the best mode of improving the navigation of the Ribble.

It appears from the Sailing Directions of the late Mr. Murdoch Mackenzie, who was employed by the Admiralty, about the year 1770, to make a survey of this coast, that the Ribble was then very little frequented, and that only by small vessels. He describes the channel as "crooked, without buoys, perches, and distant land-marks;" and adds, "that no direction will be sufficient for a stranger," to enable him to navigate it.

Since the period of Mackenzie's survey, very considerable improvements have been made upon the navigation of the Ribble, particularly under an Act of Parliament, obtained in the year 1806, by a company of proprietors. This company, in aid of the pilot, has placed a number of buoys, and erected perches at the entrance of the river and in the higher parts; a number of jetties have been constructed of earth and masonry, with a view to deepen the navigable track, and perhaps also to gain land, the rental of which might be applied to the purposes of the Act. But the resources of this company appear to have fallen greatly short of their object, and the community of Preston are still without accommodation for vessels of burden, the river trade of this flourishing town and manufacturing district being still confined chiefly to flats.

The capabilities of the Ribble near Lytham are very great, and have not escaped the notice of Captain Belcher. That gentleman found the rise of tide in the channel opposite Lytham, to be no less than 23 feet 7½ inches, in the month of July, 1836; and in his observations on the improvement of the navigation of the Ribble, he even anticipates the establishment of a harbour of refuge there.

In some of the numerous reports and plans which have been laid before the corporation, it has been proposed to form a wet or floating-dock on the bed of the river, by extending walls across the navigable track from bank to bank, at various points of the estuary. The reporters cannot approve of this plan, upon whatever scale it may be proposed to be executed, as it would form a direct encroachment upon the tidal bed of the river. The mere damming up of waters, and letting them off occasionally after they have acquired a head, can be attended with no permanent scouring effects upon the great scale; for under such circumstances, the tendency of the stream is to distort the channel near the point of issue, where the force and velocity of the water is chiefly expended; and even there, to form a track interspersed with depths and shallows, and deficient in all the characteristics of a real improvement.

In noticing the principles on which the reporters propose to improve the navigation of the Ribble, they observe, that in the great bay of Lancashire, there are vast accumulations of sand at all its inlets—as, for example, at Lancaster, Preston, Liverpool, and Chester, and the shifting nature of these sand-banks is a source of much inconvenience and danger to the mariner. It is nevertheless observable, and in this place it deserves particular notice, that although the channels among these banks be partially altered and occasionally distorted, yet the depth of water at the entrance of the different ports does not appear, on the whole, to be liable to great variation. Some of these navigable channels may have more or less depth at different periods, but the oldest charts and records, to which the reporters have had access, show that these insulated banks in a great measure preserve their original positions, and that the rise of tide and depth or volume of water seem to remain constant quantities. The off shore part of Lancashire bay, according to the best modern charts, also preserves the same depths of soundings that it had in Mackenzie's time, as appears from his testimony. "The ground," he says, "along the coast is clean sand; and the depth, for two or three leagues, not above five or six fathoms. Ships in moderate weather, or when the wind is off shore, may stop a tide anywhere from three to six miles from the land." In this great bay it is observable that the Ribble holds a central position; and that the land, especially on the northern side of the entrance, stands prominently forward, forming on the whole, perhaps, the best point of departure for a ship that is to be found on this part of the coast. The mariner, with the use of well-defined sea-marks, may therefore make boldly for the Ribble, and still preserve a good offing, at those times when it is not found advisable to enter. The favourable nature of this approach, together with the reasons assigned for believing that the general features of the seaward channels are of permanent description, induces the reporters, with confidence, to recommend the improvement of the interior or higher parts of this navigation.

It must always be remembered, that the preservation of a navigable channel here depends solely on the scouring effects of the tide, and the admission of the greatest possible quantity of water from the sea. This is a species of back-water which is to be sought after, and not that which may be termed a head or dam of water. A pretty general notion prevails that the scour is produced by the fresh waters of the river, and consequently that the ebb-tide is chiefly available to this purpose. But it will be found, on careful observation, that the flood-tide is the great agent in stirring up the sand and mud from the bottom. Wherever the tide has a considerable velocity, these matters are found to be in a state of motion, as if boiling up from the bottom, while, during the ebb-tide, the water is comparatively pure, and the deposit which it is unable to carry off settles at the bottom, to be again disturbed on the return of flood tide. Where the channel has depth and the tide rises to a favourable height, as at the entrance of the Ribble, the waters of the sea preserve the level of the ocean, and upon that level flow along the beds of all the estuaries; so that the river water being specifically lighter than the salt water, floats on the surface of the tidal water, forming, under certain circumstances, two distinct strata of salt and fresh water.

In this way the floods or freshes in rivers are useful, not, however, by impinging upon the bottom of the navigable track, but by increasing the general depth and velocity of the stream.

APPENDIX B.

PRESTON.
River Ribble.

No. 164.

Stevenson, on Improving the Navigation of the Ribble.

The reporters are aware that some misgivings may exist as to the ultimate effect of deepening a track in the higher parts of the Ribble; but they feel perfect confidence in the success of the deepening operation, which they propose by steam dredging. This conclusion they arrive at, as well on account of the great rise of tide upon the coast of Lancashire, as of the depth of water which is found at the outfall of the Ribble. They see no reason why the excavated track should be liable to silt up, in such a manner, as not easily to be kept clear by the occasional use of the dredging-machine; and they do not consider it necessary to resort to the erection of walls of masonry to preserve its line of direction. The banks at the entrance of the river (as appears from Mackenzie's survey made about 57 years since, and other documents) stand free and unprotected, retaining their general form and position without any other aid than the tidal current.

The great object to be kept in view upon the Ribble is to preserve unimpaired in all the operations for its improvement, the free admission of the tidal waters and the full benefit of their natural action upon its bed.

It is by the scouring effect of the tides passing four times over the bottom, or twice up and twice down the river in the course of 24 hours, that the tendency to form alluvial deposits is to be counteracted. The reporters have no hesitation in stating, that were it not for the powerful influence of the tidal current on the shores of Lancashire, all the estuaries and harbours on that tract of coast would be moored, or sanded up with every seaward gale. In connexion with the proposed plan of dredging the track laid down upon the accompanying plan, marked No. 3, the waters of the Douglas, Savick, and Frickleton may be easily conducted into such a course as to flow into the deepened channel; and by the joint operation of the fresh and tidal waters thus collected, the scouring effect may be kept up and preserved.

The changes which at present occur in the distorted line of the channel are chiefly to be attributed to its want of depth, and there is reason to expect that the deepening process will have the effect of rendering the direction of the channel more permanent.

Upon these principles, the reporters are now successfully deepening the navigation of the river Tay, between Dundee and Perth.

Before the commencement of these works in 1835, vessels of 9 or 10 feet draught of water had to wait the return of spring-tides in the higher parts of the Tay, whereas they can now carry 12 or 14 feet water to Perth. The ridges of sand and gravel crossing the bed of that navigation have been partly cut through, and removed by the steam dredging apparatus, and partly floated away by the current. It is this effect which the reporters propose to accomplish upon the Ribble, where the tide rises fully double the height of that on the coast at the entrance of the Frith of Tay.

It may here be proper to give some description of the three accompanying plans signed by the reporters of this date, and referred to in this report.* That marked No. 1 is a chart of the navigable part of the Ribble, and a general plan of its banks between Brockholes Bridge, above Preston, and the seaward buoys at its embouchure in the bay of Lancashire.

The navigable channels and numerous sand-banks are shown on this plan as at low water of spring-tides, agreeably to the Admiralty survey of 1836. In the plan of that survey, the soundings are more numerous, but those inserted by the reporters on the accompanying plan suit its scale, and are sufficiently illustrative of the depths of the water in the navigable tracks.

For convenience of reference, names have been given to the low-water banks on either side, and to distinguish the additional names from those on the Admiralty survey, the letters are shaded with red colour.

The buoys have also been laid down in the channels from their positions taken at this time, and given by the harbour-master.

The part of the interior country which this plan embraces has the townships and villages marked on it, as also the line of the proposed ship canal from Lytham to Preston; part of the Lancaster canal has also been laid down, and portions of the several lines of railway leading to Preston, from Manchester, Bolton, and the river Wyre—works which are in the progress of execution, or have been proposed.

The plan marked No. 2 is a longitudinal section of the bed of the river, from the quays of Preston to Lytham, on an enlarged scale. For more convenient use this section is laid down in compartments, and shows the depth of water and the nature of the soil, as ascertained by a line of borings in the river.

The transverse sections taken at the points A and B show more particularly the dimensions of the channel to be excavated.

The plan, No. 3, is part of the river from the Naze Point to the quays of Preston, upon a large scale, and shows the probable line or direction of the new channel. The longitudinal section also delineated on this plan refers to the nature of the works to be undertaken from the Naze Point up the river, to the quarry.

Although the Ribble, seaward of Lytham, possesses a depth of from 10 to 20 feet at low water of ordinary spring-tides, and the rise of tide upon this line of coast is upwards of 30 feet, yet at the quays of Preston there is not a depth or rise of more than between six and seven feet of tidal water. From the depth of water and great rise of tide at the entrance of the river just alluded to, the deepening of the higher parts becomes not only practicable, but is an object worthy of the most strenuous exertions of the corporation, and of all who are interested in the improvement of this navigation. The deepening of the higher parts of the channel of this river is an operation easy in comparison of providing bulwarks against the sea, or deepening the access to a bar harbour.

It appears from the plan, No. 2, of the sections of the bed of the river, that off or near the Naze Point, there is a depth of about 17 feet at high water of spring-tides. What the reporters therefore propose is, to deepen the navigable channel from thence to the quays of Preston, so as to admit ships drawing at least 14 feet at high water of these tides.

From the borings made in the bed of the river, the soil is found to consist of sand, gravel, and clayey matters up as far as the quarry, or within about one mile of the quays of Preston.

This track, extending to about 5½ miles, the reporters would propose to excavate by means of steam-dredging machines; an application of steam, which has of late years rendered the process of excavation effective in a tenfold degree. Above the quarry there is unfortunately a band of sand-stone rock which crosses the track of the river, and extends from thence considerably above the quays of

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* Nos. 1 and 2 plans and sections are not printed, the additions to No. 3; as annexed, it is thought will be sufficiently explanatory of Messrs. Stevenson's views.

APPENDIX B.

PRESTON.
River Ribble.

No. 164.
Stevenson, on Improving the Navigation of the Ribble.

Preston. The removal of this rock, in forming a shipping track, will require the more tedious mode of excavation, by means of quarrying; but the materials obtained in the course of it may be turned to useful account.

During this process, however, a temporary change in the current of the river will be necessary. The average depth of dredging the soil between the Naze Point and the quarry, to obtain the contemplated depth of about 14 feet at high water, appears from the sections to be about five feet. In the lower parts of the navigable track, it would be desirable to form it about 30 yards in width; but this will depend a good deal on the nature of the soil. In the higher part where rock occurs, the excavated channel might be reduced to about half the breadth of that proposed to be made by the dredging apparatus, as vessels would then be approaching the quays, and be in a more manageable track.

The exact line of direction to which the dredging operations should be confined, will also depend somewhat upon the nature of the ground when it comes to be opened; but generally speaking, it will follow the line coloured red upon the plan marked No. 3, or the course of the present navigable track, excepting where it becomes tortuous.

The materials excavated in the course of the operations will be disposed of in making up low and waste lands, in such situations as shall not contract or limit the region of the tidal waters, the flux and reflux of which must nowhere be impeded.

The reporters have no doubt that by these means a navigable channel may readily be made available to shipping, by the process of dredging, to within about one mile of the quays, and that by a further excavation in sand-stone rock above the quarry, vessels drawing 14 feet water may be enabled in spring tides to proceed to the quays of Preston. This, as a first step, would open the port to a large and most useful class of vessels, of from 200 to 300 tons burden; after this shall be effected, other measures might be resorted to for the improvement of the port, without undoing anything that shall have been done.

During the first season, the reporters would confine the operations to dredging the navigable track between the Naze and the quarry.

This process includes no uncertainty arising out of an engineering difficulty, nor does it require a very large expenditure of money, as will appear from the annexed estimate. This operation also possesses the advantage of being the necessary forerunner of any improvement which may be subsequently undertaken. Should it not be thought advisable to carry on the excavation of the sand-stone rock simultaneously with the dredging, the improvement of the channel below will of course be less effective than if the rock were removed; but the extension of the excavation to Preston quays can afterwards be undertaken, without incurring the loss of anything that has gone before.

But the shipping which it would ultimately be desirable to accommodate at the port of Preston, in connection with the manufactories of Lancashire, must be of greater draught of water than vessels drawing 14 feet, or such indeed as are likely, under any circumstances, to find accommodation, in the higher parts of the Ribble. When, however, this further extension of accommodation, or greater depth of water shall be called for by the trade of the district, docks upon the great scale may be established lower down the river. If such an establishment were resorted to, a communication with Preston might be formed, either by a ship canal, as proposed by Mr. Fletcher, an engineer of great experience, or by a railway, with locomotive engines. By the canal, larger ships might be made to reach Preston, than by deepening the river; and by a railway, docks at Lytham would be brought within half an hour's journey of the town.

The plan proposed by the reporters for the execution of these works is, in the first instance, to deepen the channel by dredging, as before noticed between the Naze Point and the hand of sand-stone rock, which appears at the quarry. This, in all probability, would employ two steam dredging machines of 12 horses' power each, with a suitable attendance of punts or lighters, during the course of about two working seasons.

The excavation of the sand-stone rock in the bed of the river, and the formation of a floating dock near the town, would be the second department of the proposed operations; but this the reporters would not propose to commence till the second season. Upon the cost of this department they do not now enter, being in want of a greater range of borings, and further observations upon the valley of the Ribble to enable them to entertain this view.

With regard to any third department, such as the formation of a dock at or near Lytham, as has been proposed, and a ship canal or railway from thence to Preston, the reporters are also at present unprepared to give any definite opinion. This seems to be of less consequence as the three departments of the general operation are conceived in such a manner as to be independent of each other; and as the execution of the first part of the improvement does not necessarily involve the subsequent excavation of the sand-stone rock, while the dock at Lytham is independent of both.

To complete the efficiency of the improvement of the navigation of the Ribble, a light-house and other distinctive sea-marks upon the land connected with the entrance of the river must be established; and the introduction of a tug steamer and a proper pilot-system ought naturally to follow the acquirement of a greater depth of water.

The execution of such improvements would afford good ground for expecting an increase of the trade, and a much greater return from harbour dues.

ROBERT STEVENSON and SON.

To the Worshipful the Mayor and Common
Council of Preston.

Estimate of the Expense of Improving the Navigation of the Ribble, from the Naze Point to the Quarry, about one mile below Preston Quays.

	£.	s.	d.
For 2 steam dredging machines complete, of the power of 12 horses; the bead cranes to be worked by steam, with Turnbull's gearing	5,800	0	0
For 30 punts or lighters, with their boats and tackling complete, at 75*l.* each. . . .	2,250	0	0
For working the 2 steam dredging machines and 30 barges two seasons, or 18 months, including 60 men, 2 foremen, 1 superintendent, tear and wear, &c., at the rate of 327*l.* per month	5,886	0	0
For incidents upon 13,936*l.*, at 15 per cent, ...	2,090	8	0
	£16,026	3	0

APPENDIX B.

PRESTON.
River Ribble.

No. 164.
Stevenson, on Improving the Navigation of the Ribble.

Edinburgh, 30*th May*, 1837.

THE reporters received through Mr. Park, the corporation's surveyor, while in London, a small pamphlet, containing remarks on the improvement of the Ribble, and several other documents, relative to which their opinion is requested by the corporation.

With regard to the system of cauling, or forming jetties on the banks of rivers, as alluded to in the pamphlet, the reporters beg to refer to their report of 16th March last. They may further observe, that such projections are very common, both with a view to protect the land, and also to straighten and deepen the navigable channel. Nor are such accessary works to be wholly overlooked by the reporters, in the improvement of the Ribble.

On the Clyde, which is more particularly referred to, jetties have been extensively employed in the higher parts of the navigation; it is, however, to be observed, that the bed of this river has a very gentle declivity, perhaps not more than a few inches, in a track of the same extent as that of the Ribble, from Lytham to Preston; while the tidal waters at the entrance of the Clyde do not rise more than about one-third of those of the Ribble. From this statement it will be seen that the current of the Clyde must be extremely languid, and consequently, the introduction of jetties had little effect in creating irregularities in the bottom of the river; whereas, if the rise of the tide had been great, and the current strong, a contrary effect would have been produced. But still, with regard to jetties, their effect in deepening the Clyde were not very beneficially felt, until these cauls or jetties were connected by parallel dykes, in the direction of the stream, an operation which altogether has occupied upwards of half a century. But even with these aids, the deepening effect was not striking until the steam dredging apparatus was brought into use.

With regard to the steam dredging machine, it has been comparatively of late introduction; prior to it the use of cauls and hand-dredging were the general means employed. The reporters may refer to the present practice on almost all the navigable rivers in the kingdom; on the Clyde there are four dredging machines in use.

The reporters are well acquainted with the situation and effects of the sea upon the breakwaters both of Plymouth and Cherbourg; but the proposed works on the Ribble are not only retired from an exposure to the sea, but lie in the direction of the current, and not athwart it.

The reporters have considered the terms and conditions proposed to be entered into with the existing company of proprietors, for the improvement of the navigation of the Ribble, and are of opinion, so far as they are enabled at present to judge, that the terms are fair and reasonable between the parties.

They are further of opinion, that an amendment to the Act of 1806 is the proper parliamentary measure now to be brought forward; and that the Liverpool Act, on the one hand, and that of Lancaster on the other, should, generally speaking, be the guides in forming regulations and a schedule of dues for Preston.

With regard to the capital necessary for the new company, the reporters beg to refer to their estimate of 16,026*l.* 8*s.* If to this be added a sum for excavation in the sand-stone rock, for the erection of a light-house, and the other contingent works of the new establishment, the capital may with propriety be extended to about 30,000*l.*, though it would have been desirable, as alluded to in their report of 16th March last, to have had more precise data in making an estimate of this kind.

It is submitted, that it would be premature to go to Parliament for the establishment of docks; by which a large sum must be provided without the immediate demand. It generally happens in works of this description, that an amended Act is required, and therefore, when the proper time arrives, it may be found convenient and useful to go to Parliament for more extended powers, and an increase of funds.

The reporters are not prepared to give an opinion relative to re-claimed lands on the banks of the river, in connection with these operations. It is not their object to acquire land, but to preserve the greatest quantity of tidal or back waters.

ROBERT STEVENSON and SON.

To the Worshipful the Mayor and Common Council of Preston.

No. 165.
Williams, on Lighting the Ribble.

No. 167.

Report of Lieutenant WILLIAMS, R.N., *on Lighting the Ribble.*

Douglas, Isle of Man, 19*th May*, 1846.

SIR,

I have the honour to acquaint you, that in pursuance of the orders received, dated 2nd May, 1846, I proceeded to Lytham, on the 9th instant, and examined the Channel, fixing the buoys, and obtaining some depth in the offing.

The present water over the bar is from 4 to 5 feet, low-water springs of 28 feet, and lies off the buoy marked No. 2; the breadth of the entrance is about one-third of a mile.

The buoys are all placed in the best of the Channel, and from the constant varying of its feature, they are, under the direction of the harbour-master, shifted as occasion may require. In reference to the position of a lighthouse, and also for the buoys, as well as for the soundings obtained, I have the honour to refer you to the accompanying plan.

For the greater safety and facility of vessels trading to the port during the long winter nights, a lighthouse placed in the position marked A, as shewn in the chart, would enable the mariner to keep a good offing; picking up the Nelson Buoy (which lies in 7 fathoms water, with the bearings and distances as follows, viz.):—

From Nelson Buoy.

		Miles.
Ribble Land-mark . . .	S.E. by E. $\frac{1}{2}$ E. . . .	Nearly $7\frac{1}{2}$
Blackpool Old Church . .	E. $\frac{3}{4}$ N.	„ $7\frac{1}{2}$
Southport Church . . .	S.S.E. $\frac{1}{2}$ E.	„ $9\frac{1}{4}$
North Meols	S.E. by S.	„ $10\frac{1}{2}$
Lytham Church . . .	S.E. by E. $\frac{1}{2}$ E. . . .	„ $8\frac{3}{4}$

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PRESTON.

No. 165.

Williams, on Lighting the Ribble.

and give him, by the exact knowledge of the locality of his vessel, the opportunity of placing her in the best possible situation until day-light, preventing him getting to leeward, or being drawn too far in by the indraft of the Ribble estuary.

It would be advisable that the light should, for a further guidance, be not visible when to the eastward of S. by E. ¾ E., so as to keep vessels off from the Blackpool shore, or falling down on the back of the Ribble banks to the Eastward; indicating, also, in the present state of the Channel, the deep water near the buoy marked No. 5, leading the pilots up to the proper place for anchorage.

For the smaller vessels or fishing craft that frequent the port, and whose local knowledge, with the assistance of a subsidiary light, properly placed, would be the means of their obtaining not only shelter but safety.

It is essential that, as well as the fixed light before alluded to, a tidal light be placed in the direction of the entrance of the Channel, to be so constructed, that, on the shifting of the bar, it could easily be removed; and that, at the proper times of tide, it should be attended to by the light-keeper of the fixed light. It might also, perhaps, be fitted with Mr. Rettie's tidal shades, to indicate the depth of water over the bar at certain periods, and thereby give the smaller craft the earliest opportunity of gaining their port.

The reasons for choosing the site of the fixed light in the position recommended are as follows:—

1st. Being on the point of rounding, it admits of a greater range for obtaining a line of leading lights, should the Channel at any time admit of it.

2nd. If the present course should alter, and break through the swatch, as shewn in plan, or go back again to the old course of the Channel, it would be equally, if not more, useful.

I have, &c.,
E. WILLIAMS, *Lieut.*

Captain Beaufort, R.N., F.R.S.,
Hydrographer, &c. &c.

CHESTER.
River Dee.

No. 166.
Evidence taken on the 17th Oct., 1845.

No. 166.

PORT OF CHESTER.—RIVER DEE.

Examining Commissioners—R. GODSON, Esq., Q.C. and M.P.; Capt. WASHINGTON, R N.

Present:—CHARLES POTTS, Esq , *Mayor;* Mr. WEDGE, *Agent of the River Dee Company;* several of the Town Council and leading tradesmen of the city; Sir. E. WALKER, Knt.; Mr. FAULKNER, *Clerk to the Pilot Trustees;* Captain COLE, R.N., *Agent to* Admiral DUNDAS, *the Collector and Comptroller of Customs;* Mr. DAVID STEVENSON, C.E. *to the River Improvement Company;* Mr. NEWTON, *Assistant to* Sir JOHN RENNIE, *Projector of the Ship Canal;* Mr. WALKER, *Solicitor to that project;* Mr. HOSTAGE, *Solicitor to the Hull and Holyhead Railway Company, &c. &c.*

The MAYOR stated that he regretted the absence of his brother, who was attending Knutsford sessions as the clerk of the peace, and who, as agent to the River Dee Company, could have given the fullest information on all points connected with the tenure of that Company. However, he would attempt to supply the necessary information, and be proceeded to explain what little he knew, but he did not wish it to be taken as positively correct, inasmuch, as when he was partner with his brother, he had not interfered with the business of the Company. The rights and obligations of this Company were based on certain Acts of Parliament, vesting in them the whole of the white sands from Wilcox Point to the Point of Ayr, they undertaking to make and maintain a tidal channel 16 feet deep up to the former point. Subsequently, this depth was reduced to 15 feet, by Act of Parliament; and formerly the river had flowed over the whole estuary up to the city walls, and the navigation was nearly silted up. The present works were originally designed to be carried out by the corporation: and that body obtained power to levy certain dues in order to defray the expense of inclosing the channel within a narrow compass on the Flintshire shore. Subsequently, the Corporation conveyed their rights to a person named N. Kindersley, as the nominee of the present joint stock company, and the agreement with him was embodied in the river Dee Acts of incorporation. The plans originally devised had been mainly adhered to, and the effect had undoubtedly been to give a better navigation than theretofore existed, and also to enclose on the Cheshire shore about 5000 acres of land, now forming the River Dee Company's estate; and about 2000 on the Hawarden shore, now the property of the adjoining landowners. For the first 50 years the River Dee Company had not realized any dividends on their capital stock, and latterly they had divided about 4 per cent. per annum. Their present rental was about 8000*l.* per annum; and the whole of that was liable to be seized and applied to the improvement of the navigation, until the tidal channel was made fifteen feet deep in moderate spring-tides. With respect to the dues to which they were entitled, he believed that they could not collect them until that depth was made, and only during its maintenance. They had been collected for a considerable period, but about 30 years ago the River Dee Commissioners interfered, on the representation of the late Lord Amesbury, who represented that this Company had not complied with their obligations under the statutes, and since then no dues had been collected.

Mr. FAULKNER stated that the rights of the citizens in the estuary of the Dee had been acquired in very ancient times by charters from the crown, and several confirmatory charters were now in existence. By the 28th of Edward the First, all that the crown possessed was granted to the mayor and citizens on the payment of a fee-farm rent of 100*l.* per annum. Under those charters the town council were entitled to various river dues, and now collected an anchorage shilling upon every vessel anchoring in the river or estuary, and which was applied to the general purposes of the borough. It was received by the officers of the Customs, who paid the amount, less a per centage for receiving, to the treasurer of the borough.

Mr. FAULKNER then drew the attention of the Commissioners to his construction of the effect of the river Dee Acts. In the earlier Acts under which the River Dee Company acquired their rights

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through Nathaniel Kindersley, the River Dee Company had a certain number of years allowed in which to complete their works, and for the purpose of those works, and for the benefit of the navigation, all the sands were granted as before stated; but all the rights of the corporation were reserved. He contended that after the time stipulated, that under that Act all the lands subsequently enclosed belonged to the corporation, and not to the River Dee Company.

The Mayor said that Mr. Faulkner had taken a most erroneous view of the effect of the River Dee Acts.

Commissioners. What was the gauge as to the depth of the navigation? He said that by the Act it was stated that the River Dee Company should maintain a standard. He read the clause of the 6th Geo. II., relating to the standard, by which it appeared that the height of the depth of water at a moderate spring-tide should be reckoned at nine feet above the bottom or apron of the tengate sluice, as the same was marked on a pile called the standard, and that the River Dee Company should cause two other piles or standards to be erected and kept in repair, in such parts of the river as the two supervisors shall think fit.

Mr. Wedge, agent of the River Dee Company, said that the standard had not been in existence within his time, nor had he ever been able to make out satisfactorily what were the true *data* upon which to erect another. He had known the river above 60 years, and had never seen the standard. With respect to the duty of properly supervising the river according to the Act of Parliament, he said that in the outset the River Dee Company had appointed a supervisor, in 1744; but the town council had not done so until about the year 1800. At that time complaints were made about the state of the river by Mr. Dixon, a merchant, and the Company were called upon to restore the standard, which he (Mr. W.) attempted to do, on the evidence of an aged man, who had been the supervisor to the Company. He got the best *data* he could from him, and on that he constructed the present standard at the Sluice-house, but it had been deemed unsatisfactory, and consequently had not been adopted by the River Dee Commissioners.

Mr. Faulkner said that the site of the ancient standard was now enclosed.

Commissioners asked if any party had wilfully and maliciously destroyed the standard, because, if they had, they were liable to a penalty of 200*l.*? Or had the Company ever proceeded against any party for that penalty?

Mr. Wedge. No. He repeated that he had attempted to reinstate the standard, but had failed to satisfy the Commissioners, although the level corresponded with the *data* upon which Holden computed the tides in the Mersey.

The dues were collected until the late Lord Amesbury complained, somewhere about 1816; he was unable to tell when they were first collected; nor did he recollect what they made. He had not his books there, nor could he give any specific information on that point. The dues used to be collected by the officers of Customs, who paid them to him, and the amount went into his general receipts on account of the river Dee estate. He had been agent since 1788, but he could not tell if the dues were then paid to him, nor when they were discontinued.

Captain Rowlands said he had paid the dues, in 1815 or 1816, to Mr. Lewis, who then collected them on behalf of the Company.

Mr. Wedge said that he had no doubt the dues had been received from the beginning; he, however, could not tell what had been paid except he was at home.

The Commissioners complained of the difficulty of getting information. The Commissioners had the power to sit either in London or in the outports. They came here for the convenience of all parties concerned; and it was trifling with their time and powers, and also with the public interests, unless parties gave them full evidence of all they knew. Unless persons like the agent of the River Dee Land Company chose to state fully all that the Commissioners had a right to inquire about, he should force them to appear before a quorum of Commissioners in London at their own expense. They could gain nothing by being reserved. He now wanted to know when the dues were first collected, when the collection ceased, and what was the annual amount?

Mr. Wedge said that he had no doubt the dues were paid from the time the main works of the Company were concluded, until Lord Amesbury interfered, and put a stop to them. He could not tell the amount, except by reference to his books, which he had not there.

Commissioners said that the books must be produced, unless the requisite information could be supplied without. He then called upon the officers of Customs to see if they could supply the deficiency.

Mr. George Smith, comptroller, said that the collection of these dues had not gone into the books of the Board. They were collected under a private arrangement between the Company and the officer; and none had been collected during his time.

Mr. Wedge was then sworn to give evidence; and he stated that the amount had fluctuated. He would, however, give some *data.* When the Ellesmere and Chester Canal Company obtained some power relating to their navigation, and feeding the canal with water, it was supposed that that undertaking would operate prejudicially upon the trade of the river; an arrangement was made between the two Companies, to the effect that the Chester and Ellesmere Canal Company should guarantee the River Dee Company 200*l.* per annum, so that whatever the dues were less that sum the Chester and Ellesmere Company made it up.

Commissioners said—Then we may now take it that the average receipts of the River Dee Company were 200*l.* per annum. Was that sum applied to the purpose of the navigation, or what was done with it?

Mr. Wedge said that the amount was brought into the general accounts, and not applied specifically to the purposes of the navigation. The works for the improvement and maintenance of the navigation were, however, always paid for out of the general fund.

Commissioners. Taking 200*l.* per annum as the average receipts from the commencement, it appeared that 17,000*l.* had been received in dues alone, not one shilling of which had been specifically applied to the purposes of the navigation.

Mr. Wedge stated that the new embankment had cost 15,000*l.* He could tell the date of every embankment, and also the cost, from the books of the Company.

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Mr. Wedge said, that with respect to the obligations of the Company to make two other standards that had not been complied with. He could give no explanation of it, as it was before his time.

Mr. TREVOR wished to know if the River Dee Company had ever protested or resisted the abstraction of the waters of the Dee at Bala Pool for the purpose of feeding the Ellesmere and Chester Canal.

Mr. POTTS said their attention had undoubtedly been called to the encroachment, or they would not have stipulated that their dues should be guaranteed at 200*l.* per annum.

Several parties explained that at the time the weir was erected below Bala Pool, by which the canal was filled before any water whatever could find its way into the river, although Bala Pool was the source of the Dee, it was understood that that water was to be emptied into the Dee at Chester; but of late years there had been considerable works at the terminus of the canal at Whitby on the shores of the Mersey, by which it appeared that the great body of the water went into the Mersey instead of the Dee.

[At this stage of the proceedings several maps and plans were handed up to the Commissioners by citizens. One of them was evidently very old, and was a map of the city and river before the present works were begun, by which it appeared that the channel was on the Cheshire shore, and that the present channel was designated "the projected new channel." Another was a map of the River Dee Company's estate, delineating the several allotments to the neighbouring landed proprietors. The agent of the River Dee Company undertook to furnish the Commissioners with a copy of the latter.]

COMMISSIONERS. What was the present trade of Chester?

Mr. SMITH, comptroller of Customs, said that he had not any statement prepared. The books of the Customs were all destroyed some years ago by the great fire at the London Custom House.

WILLIAM MANIFOLD, a carpenter, produced his books as supervisor of the River Dee Company. On the 15th of September he took the depth as usual, at Morgan's field, where there were 19 inches at low water, and 11 feet 3 inches at high water, at a 17 feet 8 inches tide on Holden's table.

Mr. FAULKNER, as clerk to the Point of Ayr Trustees, stated that the light at that place erected under the Act was now vested in the Trinity House, but the right to appoint pilots, and the duty of superintending the pilotage, remained vested in the trustees, who, however, were a body without any funds. The ordinary practice was for persons, who wished to be appointed pilots, to produce certificates of competency, signed by masters and owners of vessels and others interested in the trade of the river, and also testimonials as to character. Latterly, however, the trustees had determined that the men should be examined also by competent persons, and Captain Evans was entrusted with that duty, since which several appointments had taken place.

Capt. COLE, R.N., stated that he would render any service that lay in his power as sub-Commissioner of pilotage.

JOSEPH GARRATT, pilot, examined.—I have been a pilot thirty years; I was appointed by the trustees; there are ten pilots; I did not pass an examination: I had a character as an honest sober man, and also one from masters of vessels; I have known the river 56 years; when I first knew it, I was about nine years of age: twenty-five years ago I brought a vessel up to Chester, drawing 12½ feet in a sixteen feet tide; it was the "Wellington," belonging to Mr. Dixon of Chester; the river is not so good now as it used to be; I don't find any difference on the bar; at low water spring tides there are 12 feet on the bar; the shoalest water on the bar at any time is 10 feet; the bar has not altered because it has a hard bottom; when I was first appointed pilot, I could bring a vessel drawing 12 feet to Chester; I think I could also bring up a vessel like that now; I don't think the river is any worse now than then; it was worse some little time since; I think the late freshes have improved it a good deal; the river is now better than for the last ten years; it is always better in winter than summer; there is not so much dry weather in winter, and we have better freshes; since the canal was cut the freshes are not so strong; all the pilots have always said that the canal ruined the river; the deep water channel is now on the Flintshire shore; twenty years ago it was nearer the Cheshire shore; I think the tides in general run about seven knots; I think the river is better when the floods and freshes can scour the channel well; if the scouring could be improved the river would be improved; when there are no freshes the river silts up; I don't think the embankments have caused the channel to alter; I recollect a vessel getting on the embankment; she lurched off and sunk, and is there now; I don't think vessels ought to come up the river in the dark; they run a risk because the walls or dikes are in the way; the vessel I mentioned belonged to Mr. Joy of Dublin; the River Dee Company built the walls; there are jetties all along the Welsh shore; there are none on the Cheshire shore.

By Mr. WALKER.—I recollect a vessel carrying government stores being on shore at Hoyle some time ago; I believe she had no business there, as she was in the track for Liverpool.

Mr HUGH JONES said that about six weeks ago he had some powder on board a vessel called "The Collier," about sixty tons burthen, and drawing 8 feet water, and she was detained nine days at Flint for want of water.

Captain JOHN ROWLANDS examined.—I have known the port of Chester nearly fifty years; the river was better then than now; we could then beat with cheese brigs up to Connah's Quay in a foul wind, at moderate spring tides; we cannot do so now; I attribute the deterioration of the river to two causes—the obstruction of the water, and the river being neglected, instead of being taken care of as at other places; I have known great quantities of ballast thrown into the river, which has had a bad effect; the river is not 50 yards wide at Chester Quay; it is narrowed from the accumulation of silt; there has been no dredging to deepen or maintain the channel; I consider the River Dee Company ought to have looked to that; I have paid dues to the Company; I do not know how those dues have been expended; the Company have erected stages, put down mooring posts, and erected a quay at Connah's Quay; vessels pay wharfage at Chester quays; in all other ports we get accommodation in lieu of what we pay; the bar of the river is much the same as I always recollect it; there have been constant alterations in the channel up to Flint; the channel goes towards Dawpool, and then towards Flint; the variation of the channel below Flint is often as much as a mile; the buoys are, or ought to be, shifted as the channel varies; that duty devolves upon the man appointed by the Trinity House; the buoys were put down about twenty years ago; I think the River Dee Company did not put any buoys down, nor the Point of Ayr Trustees; they were first put down by the Trinity House men; I have complained to the agent of the River Dee Company of the changes of the channel not being indicated, and he has put down perches according to my suggestions; there has been nothing done for the improvement of the navigation below the present works of the River Dee Company; the perches put

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down were not much thicker than a broomstick; the perch on Pentre rock has a barrel; it was placed there by the River Dee Company; the jetties and groins placed in the channel are all dangerous for vessels to get upon; I have known several vessels to get upon them; I recollect Mr. Joy's vessel being wrecked; I know of Mr. Gaman's flat getting on the causeway, where it remained five or six days; I recollect a steam packet getting on in the day time, and being wrecked; some of the works are of the nature of sunken rocks, and sunken rocks are the most dangerous to ships; these works are like sunken rocks at half tide; vessels cannot navigate the Dee with safety in the night; I should bring a vessel to anchorage rather than attempt it; if the river were properly buoyed and lighted, then the Dee might be navigated in the night as well as the Mersey; the River Dee Company have enclosed many thousand acres of land out of the estuary, and I think that part of their revenues ought to have been appropriated to lighting and buoying the river; the river suffers much from silt; one cause of the accumulation of silt is the want of such water for scouring power; a sixteen feet tide will cover Chester causeway at the Dee mills; it will flow a long way up the fresh water reach; I have always considered the weir or causeway a great injury to the river; I see no objection whatever to the river being dredged, but I should also wish for more scouring power, if it could be obtained; the channel is all sand; I have sounded at the ends of the groins; there is no mud or gravel for a considerable depth, but all is sand; a good scouring would tend to keep the river clear; I give no opinion as to dredging, as it is an engineering question, but anything that would give a better and defined channel, more water, and an earlier tide, would benefit the navigation; I am of opinion that if the present wall was extended more to the northward it would have a good effect; we should then have the channel steadfast; I think it desirable now that the channel should be continued on the Flint shore; if it had been originally kept on the Cheshire shore, it would perhaps have been better for the river, and perhaps for the trade of Chester; I consider it impolitic, if not impracticable, to alter the direction of the channel, now the principal trade is on the Flint shore, caused by the large mineral interest; there is no depth on the Cheshire shore till we get to Dawpool; vessels can anchor there in five fathoms' water; there is fourteen feet on the swash, but the swashway is liable to alter, it is buoyed out by the port of Liverpool; before the river was silted up, the Irish mail packets used to moor off Parkgate; forty-five years ago they could have run up to Parkgate at low water, that is, vessels drawing six feet; the alteration is now very considerable; Parkgate is now dry at quarter tide; the back water is now destroyed by the enclosures; about twelve feet of sand have accumulated; I do not know of any complaint that has been made about it; it was thought of no use to make representations of this state of things, for it was supposed that the Company had a right to get all the land they were able by their Act, and that they were resolved to get it as fast as they could.

The MAYOR here stated that the Company had always done whatever Mr. Telford, their engineer, recommended, and that they had laid out a large sum of money in laying down groins and other works which were considered useful, but which appeared now to be subjects of complaint. If the Company had done wrong, they had been misdirected.

The COMMISSIONERS at this point referred to the Act, and said that it was surprising, under the state of things as represented by the evidence, that the proper parties had not distrained upon the rents, issues, and profits of the Company, and applied them until a fifteen feet channel should have been made.

Mr. WEDGE said, that in all that had been done with respect to the river, Mr. Telford had been consulted, and all that he had advised had been carried out. Mr. Kindersley had originally put down the groynes; and in his day there were two, where there was only one now; and vessels often got on them at low water. It was in consequence of the complaints that Mr Telford had been employed; and the groynes had been put down where he recommended, and when the jetties got shorter they were restored to their former length. He also stated that the flood flowed two hours, and the tide ebbed ten hours; that caused the deposit of considerable silt, and the object of contracting the channel was to get a better scour from the land floods. The new embankment was made on his recommendation, and it cost about 15,000*l*.

Mr. WEDGE said no land whatever had been acquired by the Company in carrying out Mr. Telford's plans, and he here reminded the Commissioners that he was on oath. All the instructions given to Mr. Telford were for the sole object of improving the navigation, and his plans had been implicitly acted upon. If the works had not had the anticipated effect, it was no fault of the Company, who had followed the plans of the most eminent man of the day.

COMMISSIONER. It appears that, in 1786, vessels of 100 tons burthen were built and launched at Parkgate.

Captain ROWLANDS said there had been ship-building there for a great number of years. He recollected the yacht of the Lord Lieutenant of Ireland being moored off Parkgate, which was at that time the mail packet station.

Captain CURTIS examined.—I have known Chester river nineteen years; the river was much better then than now; it was six feet deeper; the bar is twenty miles from the causeway; the works up the river have not affected the bar; I find the channel below Flint alters every spring tide; it had altered between Connah's Quay and Dawpool; formerly we had more water; we used formerly to ride below Dawpool, but we don't now; the evil is that the river has been neglected instead of improved; my vessel draws from 12 to 13 feet water; last December I was obliged to take 140 tons out of her in a 17 feet spring tide, and then I could not come up to Chester, although only drawing 8½ feet water; the River Dee Company have been constantly at work throwing stones into the channel of the river, and anything but improving it; these stones were said to be for the purpose of preserving the cops; the bottom of the river is sand, and if there was a good scouring tide twice a day, it would do all the good in the world in keeping the tide way clear; I think the weir at Chester a great obstruction to the scouring; the channel is not very fit for purposes of navigation; I cannot drop my ship with safety; my ship is 72 feet in the keel; I know no river so bad as Chester river; I have known several vessels refuse freights for Chester river; if I were not in the cheese trade I would refuse them, because I consider it not a safe river; I have known vessels to get on the groins; I have been aground for want of water; I think the channel might be easily deepened and improved; the Dee is wide at the mouth and narrow at the entrance of the tidal canal; the Mersey is the reverse; the effect of the scour at Liverpool is to clear the mouth of the bottle; the back water here is not sufficient to carry out the sand; if we could get a better force of water that might be done; the present walls of the Dee Company are badly planned for keeping the river straight; there is a large trade in the river, and it

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would be greatly increased if there was sufficient water, and the navigation was otherwise improved; the channel from the Point of Ayr to Dawpool is good enough at high water; there are five fathoms in Dawpool at low water; I can lie afloat at Dawpool, but I should not like to run in; I should never think of doing so; I should not have cable room; there is only forty-five fathoms' width in the pool; in fact, it is only a pool; Dawpool is no roadstead at all, at either high or low water; the best deep in the river is the Mostyn deep; there is seldom a gale of wind but there are wrecks off Hoylake; we want lights and beacons in Chester river; if the river were properly buoyed and lighted, I would rather come over Chester bar than over the Liverpool bar; but we have no right guide for Chester bar, or it is greatly the best; the present buoys are too small; we can only see the buoy on the middle patch when we get at it; when the danger is past it is useful, but not before; we want some improvement on the southern extremity of the middle patch; we want a light ship, and also a better adjustment of the Point of Ayr light; the pilots do complain of this light, but they get no redress: it is no use for masters of vessels to interfere: the pilots complained lately when the Trinity yacht was there that the buoys were not sufficient; one chief difficulty now is, for proper guidance to get over the bar; if we had a light ship, and the river was improved, the expense would soon be paid; when I got in the river I should leave Dawpool on one side; I don't think Dawpool safe in a north-west gale; I should anchor in the Wild roads; if there was a good river, I would rather come right up to Chester than stop at Wild roads; I can come into Wild roads at low water; I could bring in a seventy-four; I could not get into Dawpool at low water; the best water is direct up, and not through the gut at all; I came over the bar at dead low water this trip, drawing 10 feet 7 inches; I can't get to Dawpool until quarter flood; the ebb from high water to low water at Dawpool is 150 yards; in a north-west gale, I would rather take Chester than Liverpool bar, if properly buoyed; there is a great deal of hazy weather on this coast; I think a bell in the inner buoy would be an advantage.

Captain **THOMAS EVANS** examined.—I have been at sea several years, and also master of a vessel; I don't know much of the lower part of the river; between Flint and Chester, there were five years ago four feet more water than now; the channel has silted up through the state of the freshes; if there was a good scour of either tidal water or freshes it would clear the river; the river began to get worse about three years ago; within the last four months it has improved; that is in consequence of the freshes; from March, 1844, to the middle of the present year very little fresh water came over the causeway; it was seldom within a foot of the top; the tide frequently flows above the causeway; it is obstructed at Boughton ford, where sometimes there is not more than a foot of water; in high tides the tidal water will go many miles above the ford; the back scour would be improved by the removal of the causeway, and the lowering of the ford; the bridge now erecting by the Holyhead Railway Company is an obstacle to the tidal influences; it would prevent any navigation, except by flats and lighters, up to the Dee Mills; thinks the river might be materially improved; considers it desirable to keep the channel on the Flintshire coast. He also thinks the pilots want looking after; there is no head to keep up a proper supervision; there are no harbour trustees nor harbour master. The reason why there was no trade was because there was no river; if the river was in a good state, the vessels carrying ore, &c., would prefer coming to Chester to going to Liverpool, as they would then get back freight of coal; if they had more water they would have more trade; he did not expect that all the Irish trade would come here; but they would have their share. A deeper channel might be got on the Cheshire side, but he hardly thought it desirable, as the trade at present all lay on the Welsh coast.

The COMMISSIONERS then said, that having now taken evidence as to the powers and liabilities of the River Dee Company, and also as to the state of the river from pilots and masters of vessels, they would now hear evidence as to the projects for improving the navigation.

The MAYOR then stated in brief the two projects lately brought before the public meeting; and also the result of that meeting.

The COMMISSIONERS called upon the engineer of the River Improvement Committee to detail his plan.

Mr. **DAVID STEVENSON**, C.E., examined.—I produce surveys and plans of the River Dee, and also of the works I propose for its improvement: they are in a matured state, and were taken in 1839; I have again surveyed the river, and I see no reason to alter what I then recommended; I propose to improve the present tidal channel of the river by increasing the tidal influence; I have adopted the same principle on the Tay, the Ribble, and other rivers, and have been successful; I have gained five feet water up to Preston on the Ribble, by the erection of rubble walls, steam dredging, and excavations; the length of the works is above eight miles, and the cost is about 45,000*l.*; the time occupied has been four years; when I surveyed the Dee, in 1839, the depth was 13 feet at high water spring tides, that is, when the same tide rose 18 feet at Liverpool; there are several injurious obstructions in the river, such as the groins, the awkward turns, the old bridge, and the weir; the latter is 11 feet 6 inches above the bed of the river; it runs diagonally, and stops the passage of the tide except at high springs, when the tide sometimes rises four feet above the height of the weir; there are two fords above the weir, which it would be beneficial to remove; the tide would then flow up, and the increased volume of tidal water would be very considerable; the enclosures of land below Chester are about 7000 acres; the River Dee Company have gone to considerable expense in erecting banks and groins, leaving only a narrow channel, and which has not been assisted by any excavation or dredging; the tendency of these works has been to vary the course much below them, and has reduced the velocity of tides, and checked the whole tidal phenomena; they have caused a great deposit of silt, which is still increasing; the accumulation of land might have gone on, in conformity with improvement of the river, had the works been according to the principles now applied to the improvement of navigations; when the tide rises 25 feet at Flint, it only rises 12 feet at Chester; there is a fall of 11 feet from Chester to Flint, by the levels I have taken: the difference of time, as to high water, is fifty minutes later at Chester than Flint; the flood reaches Flint about two hours earlier than Chester; that difference ought not to exist; if the river was in a proper state, the tidal wave ought to travel at the rate of eighteen miles an hour; I propose, in the first instance, to remove certain jetties, as shown in my surveys; to extend the lower causeway from Barrel-perch to Pentre-rock; to remove the Pentre-rock, and to dredge and excavate the channel; I see no obstacle in the River Dee any more than in the Ribble; the expense would not be greater than my original estimate; I have tested the accuracy of those estimates by the works I have executed in the Ribble; the original plan contemplated gaining 16 feet at an expense of 25,000*l.* and the time occupied would be about two years; I should not employ more than one steam dredge; I should trust some little to the tidal scours and the freshes; the removal of the weir and fords was not contemplated by me; if they were removed, they would save considerable expense in dredging; the sand is soft and easily removed; I have bored the whole of the channel, and I find no obstructions; I contemplate removing the Pentre-rock, because it now tends to diffuse the water, and turn the channel towards the Cheshire side; I think it desirable to keep the channel on the Flintshire shore; if it was considered desirable to obtain 20 feet water, the expense would be another 25,000*l.*; I see no difficulty in getting 12 feet at high water neaps at Chester quay; the river might be further deepened two or three feet; silt would continue to be deposited to some extent.

Captain COLE said that the deposit of silt in still water was about one inch in a tide.

Mr. STEVENSON continued.—I do not contemplate dredging all the way to Flint; of course dredging would assist even then; I do not contemplate there will be any necessity; in the Ribble we found in some cases that dredging was not necessary; the bend in the river at the cheese stage has the tendency to impede the flow of water; I should expect to increase the impetus by working the bed of the river below; I can't conceive any tidal river in a worse state than the Dee; the tidal water absolutely in flowing up the channel proceeds down a slope; that is because the tide is higher at Flint than Chester; the embankments on the river have been constructed wrong, through imperfect information as to the principles which govern marine engineering; the land might have been enclosed, and still the river improved.

By Mr. NEWTON.—The fall in the Ribble below Preston, before the improvements, was 12 feet in 12 miles; the fall from Chester to Barrel-perch is 6 or 7 inches in a mile, and from Barrel-perch to Flint it is 20 inches; in the event of getting 20 feet at Chester quay, the fall will be equalised, and will be six inches in a mile; it would perhaps reduce the velocity a little, not much, but I should get greater tidal capacity; I am not sure that the velocity would be reduced; it might reduce the low water velocity in some parts and increase it in others, the tidal water would flow in more freely, and go quicker out; I should get a better tidal scour; there would be a larger capacity to fill; in the Tay I have gained by the same operations upwards of 1,000,000 cubic yards of tide; I see no obstacles to vessels getting up to Chester in one tide; I don't see why six vessels might not get up to Chester in one tide; I don't see why six vessels might not get into the proposed docks at Chester in one tide.

Captain EVANS said that it was with some difficulty more than six vessels a tide were docked at Liverpool, and there was greater dock accommodation at Liverpool than could ever be made at Dawpool.

Mr. STEVENSON continued.—I can dredge at a cost of 6*d.* a yard, and find the machines; the cost in the Ribble was 5½*d.*; the quantity to be dredged from Flint to Chester would be about 214,000 cubic yards; I contemplate docks at Chester near the cheese stage; in the first instance they will occupy an area of four or five acres, and be enlarged as the trade increases; I know of no engineering difficulties to my plan, which I can carry out for the estimates, and produce all the results I have detailed.

By Mr. TREVOR.—I have had my attention drawn to projects for railways crossing tidal navigations. I reported against a project for crossing the Tay and the Earn below Perth; the parties proposed to cross on pile piers, and to leave an opening of 60 feet; I considered such crossing as an objectionable interference with the river, and that it would interfere with the trade of Perth; the consent of the Admiralty to that project was applied for; the Admiralty also caused surveys to be made; the Admiralty refused its assent to that crossing; the line of railway was diverted to above the quays at Perth; I have had my attention drawn to certain plans of crossing railways over the tidal navigation of the Dee; I have not had the details of those plans before me; I am opposed to those plans, so far as I can understand them; I do not think they ought to be permitted.

The COMMISSIONER said that was a most important branch of the inquiry, and he was glad it had been introduced. He was surprised that the Holyhead Railway Company had ever obtained power to cross the Dee, even on the present site. It appeared that the citizens could not obtain the same privileges when they built the Grosvenor bridge, but were compelled to adopt one arch, and to have that at a high elevation.

Mr. TREVOR said that the Holyhead Act was obtained in the last session but one, whilst the powers now possessed by the Admiralty were only confirmed in the last session.

COMMISSIONER. The Admiralty, as representing the rights of the Crown, always possessed the right of objecting to such intrusions; those rights had been allowed to remain in abeyance, but now they would be fully exercised.

Mr. POTTS produced the books of the River Dee Commissioners, in order to show that what Mr. Telford recommended had been submitted to them and approved.

The COMMISSIONER said that the question was, whether what Mr. Telford recommended had not been practically to serve the company who paid him, and not the public. He did not say that that was the case. It was not for him to give an opinion. If, in the course of the inquiry, he had done so he regretted it, as his duty there was only to inquire. The Commissioner then said that they would go into the details of the ship canal.

Mr. CHARLES HENRY NEWTON, assistant to Sir John Rennie.—I have been employed under Sir John Rennie on the Norfolk coast, and in the rivers Ouse, Wisbeach, &c. The project which he was instructed to explain, was for the purpose of making a ship canal from Chester to Dawpool, in order to avoid the present tortuous channel, and to get at the deep water in that place; I have to state that when vessels have crossed the bar, they can at quarter flood get into the Dawpool out-docks.

Captain CURTIS said that a vessel drawing twelve feet water could not get in at quarter flood, nor before half tide; the best place to go was Wild roads.

Mr. NEWTON continued.—It is proposed to cut away part of the coast from the entrance of the dock, and in the area from the lock-gates to the deep water to form a tidal harbour; the area will be about a quarter of a mile; it is proposed to supply the canal with water from the streams in the neighbourhood, and also from the surplus of the Chester and Ellesmere canal; it is proposed to supply the canal exclusively with fresh water, except at high spring tides, when they would let in the sea water; the lock would be 210 feet long, 50 feet wide, and 20 feet deep; the canal would be 12 miles long, 300 feet wide, and would cost not 42,000*l.* per mile; the docks at Chester would cost about 250,000*l.*; they had not made any plans or estimates; he produced an ordnance map, with the site of the canal and docks marked upon it; he could not tell of any other ship canal that had

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Evidence taken on the 17th Oct., 1845.

ever succeeded; he believed the Newry canal would be finished in about three years; they were now going on with the locks; they would have the plans and estimates ready in the spring.

Examined by Mr. STEVENSON.—I have not gauged the springs of water in order to get at the quantity of water they will supply; I do not know what the discharge will be; I have not considered the evaporation, if I allow 8 inches for six months I should think that is sufficient; I do not anticipate any leakage; a good part of the line of canal will go within high water mark, through the lands of the River Dee Company, and those of Mr. Lloyd Mostyn; I think there is a good deal of red marl, but I have not made any borings; can't tell the depth of cutting at Burton-head; I don't know what springs there are in the neighbourhood; Burton-head is not red sand-stone rock; the deep at Dawpool is not more than 400 yards from the high water mark, nor 100 yards from low water mark; we shall erect a solid pier; I can't give an idea of the length or breadth, but it will be made sufficient; I have not considered the effect of the pier on the currents; I have no detailed plan or estimates.

Mr. TREVON then handed in to the Commissioners a copy of a memorial from the committee of the town council to the Admiralty, praying that in all cases where the assent of the Admiralty may be solicited for railways to cross the tidal navigation, that that assent may be refused, to prevent the river from further deterioration; and to retain it in a position that the fullest improvements may be carried out of which it is susceptible.

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Telford, on the Navigation of the River.

No. 167.

Reports by MR. THOMAS TELFORD, *on the Navigation of the River Dee, between the Years* 1817 *and* 1828.

Chester, 11*th September*, 1817.

HAVING examined the present state of the river Dee, I beg leave to observe, that from the city to the first bend of the river, called the Marsh Head, or Edge, which is near to Wright's Cottage, the channel appears to be in a proper condition, but at this place, on account of eddy, there is a small shoal or bar of sand, which may be removed by extending the jetties or groins on the south side, so as to contract the breadth of the channel. At the second bend near Stow Bridge Sluice, from the same cause, there is a similar shoal, which may be removed by the before-mentioned means of extending the jetties on the south side.

No further defect occurs until opposite the windmill, where there is another shoal or bar to be removed by the same means as above-mentioned.

From this place to Gregorey's Rails (a distance of upwards of four miles), and which is the extremity of the enclosed lands, the channel is all seemingly in a proper state.

Beyond the enclosed lands, the Horse Shoe Bank extends upwards of half a mile to where the stone causeway commences, which is upwards of three-quarters of a mile in length.

On the south-west or river side of the causeway there is a considerable bank of sand, which directs the channel to Connah's Quay; this channel is, at present, in a regular and good direction. On the north-east side of the causeway, and towards the lower end of it, the sand banks are as high, and in some parts, even higher than its summit. On this account, it seems advisable to raise and strengthen the causeway, so as to prevent any bad effects from the tide carrying any sand over its top. On the opposite side of the river, it seems advisable to raise and strengthen the jetty or groin on which the upper perch is placed.

With regard to extending the stone causeway beyond the Boot Rock, it would be incurring an expense of upwards of 20,000*l.* without accomplishing any effectual remedy, because the same effects would take place at its extremity as at the present termination, that is, the channel would be subject to similar changes of direction, in consequence of local circumstances, which are not within the reach of art to controul.

The cutting away of the points of rocks on the south-west side of the river, below Connah's Quay, would occasionally, by the current of the tide, produce injurious effects, by washing away still more of the land on the Flintshire shore without procuring any adequate and permanent advantage, in regard to the general direction of the fresh-water channel of the river.

I estimate the expense of performing the operations here recommended as follows, viz.:—

	£.
Extending and increasing the jetties or groins	450
Heightening and strengthening the stone causeway, 4 feet at the lower end and 2 feet at upper	2,112
Add for contingencies, 10 per cent.	256
	£2,818

It will be proper that the whole of the before-mentioned works be carried on progressively, and with due caution.

THOMAS TELFORD.

To the River Dee Company.

Chester, 28*th July*, 1819.

HAVING in company with Mr. Wedge and Mr. Hancock examined the river from Chester to Bagillt, on two separate days, viz., the 26th and 27th July instant, at low water, and also during the ebbing and flowing of the tide, I am glad to observe an inclination of the low-water channel to change towards the southern or Flintshire shore, that is, to pass in nearly a direct line from the termination of the stone causeway towards the town of Flint, by which, if perfected, the course would be shortened nearly two miles, and the velocity of the current consequently much increased.

Under these favourable circumstances, it appears to me advisable to take immediate measures in order to promote and accelerate the before-mentioned change.

The most effectual means which occur to me are, to construct a dyke or bar with stakes or gorse, or brushwood faggots, across the old or eastern channel. This should be placed on the first shallow ford, below the end of the stone causeway. It should be begun as far up as opposite the end of the stone causeway, and worked obliquely downward across the said old channel. There should be at least three rows of stakes, but only one faggot in thickness carried quite across at one time. When these have been sanded and fixed, other courses of faggots may be added successively, until a proper bank has been formed, and the low-water channel changed.

After the new channel has been formed, it may then be found advisable to use similar means to incline it still more towards the Flintshire shore.

Working in this manner with faggots appears to me much more advisable, in such great extent of sand, than attempting to carry forward any great mass of stone-work. A much greater length of weir or embankment can be effected in a short time (while local circumstances are favourable), and less resistance being

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offered in any one place, there is less risk of the surface being broken into deep holes, but on the contrary, the general mass of surface may be expected to be regularly washed away in the direction of the wished-for channel.

After the first or upper weir has been constructed, it will be seen, whether at any particular place it may then be necessary to remove, by manual labour or mechanical means, any portion of the sand banks, which may be in the way of the new channel. It is possible that some aid may be afforded in this way, but the great agent must be the water directed and managed in the mode I have pointed out.

Besides the above-mentioned leading feature of the improvement, I recommend that the two jetties immediately above Connah's Quay be extended, until their extremities are in a line, or nearly so, with the outer point of the said quay, and that of the third jetty above it; this will, I expect, be the means not only of removing the sand bank from this part of the channel, but of regulating the course of the ebb, so as to favour the new channel below. In order to further this object still more, I advise to cut away the point of the rock on the shore immediately below Connah's Quay, so as to give the low-water channel a straight direction from the said quay downwards.

I approve much of the catch-water drain which has been cut along the Flintshire shore, and have no doubt but that the water which in winter, and during heavy rains, will be collected by it, may be directed in such a manner, as to promote and preserve the low-water channel in the desired course near to the shore.

In the upper part of the river most of what I recommended on my former survey, as to extending and increasing the size of the jetties, has been carried into effect. A few jetties yet remain to be perfected, for which stones have been provided.

THOMAS TELFORD.

Bangor Ferry, 26*th April*, 1820.

HAVING examined the river Dee from Chester to the lower extremity of the stone causeway or dyke, opposite to Connah's Quay, I find that the works formerly directed to be performed have proved effectual in regard to changing the direction of the river channel, which now, instead of turning, as formerly, at nearly a right angle to the northward, proceeds in a direct course westward towards the middle of the estuary, being the most natural direction, and that most likely to be preserved,

I therefore advise that the new faggot and rubbish stone dyke be preserved up to the level of the present sand banks, but no higher, the present position and shape of the banks being in as proper a state as can be wished.

Great progress has also been made in constructing the jetties along the banks of the river, which as far as completed, seem to have answered the intended purpose of deepening and regulating the channel, and I have only at present to advise a perseverance in completing the said jetties.

THOMAS TELFORD.

Chester, 30*th April*, 1821.

HAVING repeatedly examined the state of the river Dee below Chester, at different seasons of the year, and that for four successive years, I now consider myself prepared to report upon the several matters referred to me by the resolutions of the Committee of the River Dee Commissioners, dated 1st September, 1820.

1st. I am of opinion, that if the river channel had a straight direction from near Connah's Quay to a moderate distance, without the point to the Lamp Rock, and also without the rocks upon which the town of Flint is situated, the effect would be to scour and preserve the channel between Connah's Quay and Chester in a more effectual manner, than when the before-mentioned portion of the river is crooked, but this portion of the channel should not be forced so near to the Flint shore as to touch the hard ground, or any of the rocks, because that would have the effect of turning it out of the straight channel, and pushing it over towards the Cheshire shore.

2ndly. I am of opinion that a sufficiently straight channel, such as I have described, may be obtained by cautiously pursuing the same mode, by which the channel of the river has already been changed from its previously crooked course into one about a mile nearer to the Flint shore. This measure having been perfectly successful, I do not hesitate to recommend that it be extended of the same materials, and by similar cautious and progressive steps, in order to direct and aid the current of water in cutting away the sand bank on its western side, which it is now evidently doing, and so by degrees to get the whole channel into the desired direction. If what is here recommended be accomplished, as far as opposite to Flint, the effect would not be unfavourable upon the outlet of the river, because a straight direction for the flux and reflux of the great body of the tide is better than a crooked one. But it is not to be forgotten, that as the sands and mud accumulate, and marsh lands are formed in the upper part of the estuary, the power of scouring the lower portions is diminished.

3rdly. As the changing of the river channel by means of the Faggots weir has caused a very great accumulation of sand, not only adjacent to itself, but behind the old stone causeway, it is now become necessary that both these should be raised; but this must be progressively with much caution, of not more than one foot in height in one time, but repeating this occasionally, as there is a further accumulation of sand.

Between Connah's Quay and Chester, the groins have been generally completed in the manner I formerly recommended. They have been executed in a very proper manner, and at no inconsiderable expense. Some few yet require to be a little more extended, and others raised, which Mr. Wedge assures me is to be done. These are the measures which, in my opinion, the River Dee Company should be required to perform, and I do not see at present that more should be demanded, because these seem quite equal to the acquiring all the perfection the navigation is capable of.

THOMAS TELFORD.

Chester, 31*st August*, 1821.

I HAVE this day examined the state of the river at low water, and also the progress made in the causeway, which in my former survey I directed to be extended. I have found it extended 520 yards, which, with that formerly executed, makes in all about 900 yards from the extremity of the old stone causeway. The whole has been performed very successively, and much to my satisfaction. No greater extent should be attempted during the present season, nor should the causeway be raised any higher, until experience shows how the sands accumulate.

The effect upon the river low-water channel has been fully equal to my expectation, and this channel is evidently and daily moving into the desired direction. This operation the winter floods may be expected to promote, if not wholly accomplish.

Until the effect of the winter floods has been seen, I cannot determine the measures to be pursued next season.

Upon the whole, I have the satisfaction to observe, that the measures hitherto pursued have been completely successful; and after considering this important subject in every point of view, I remain firmly of opinion, that the same mode of proceeding should be steadily and cautiously pursued, and that no other should be suffered to interfere with it.

THOMAS TELFORD.

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No. 167.

Telford, on the Navigation of the River.

Chester, 13th August, 1822.

HAVING this day in company with the Mayor of Chester, Charles Dundas, Esq., Mr. Wedge, the River Dee Company's agent, and others, examined the state of the river between Connah's Quay and Flint, I am enabled to state, that from the quay as far as the new causeway extends, the channel is at present in a proper direction, and excepting at the lower end of the causeway, it is also at a proper distance between it and the Flint shore. The causeway itself is also well protected by newly accumulated sand banks. At its lower extremity, as was naturally to be expected, the water plays too hard against the rubble stone mound. It is at present about 18 feet in depth, and has caused a pool or wash behind the extreme point.

Between the mound and Flint, although the channel has, during the last six months, moved about 1200 yards to the westward, still a small bend remains, and it is desirable that this should be washed away, in order to acquire a perfectly direct course and the greatest possible fall. As a considerable wash already weakens the lower part of the before-mentioned bend or sand bank, there is a probability that the next great land floods will effect the whole of the desired change, by completing the new channel, and causing a sand bank adjacent to the present mound termination. If this is accomplished, it would only be required to follow the natural operation by such artificial means as then appeared most likely to preserve the newly-acquired channel: but until the effects of the aforesaid floods have been seen, no artificial measures can, with propriety, be defined.

In case the floods do not accomplish what has been described, an artificial mound or causeway similar to what has already been constructed, must be extended along the eastern bank, commencing at the same distance behind the present, as was practised with success behind the lower extremity of the old causeway. It should take an angular or curved direction for a few hundred yards, or as far as found necessary to push the channel to the westward, and cause a deposition of sand between the present and new mound.

To perform this proposed extension with a probability of success, a very considerable quantity of rubble stone and faggots must be previously provided, and it is therefore desirable that the said materials should be prepared with all practicable dispatch, but I much doubt if any actual extension of the mound can, with propriety, be attempted until next spring.

Although these are the general principles which I recommend being adopted, yet much depends upon what effect will be produced by the next great land floods, an account of which will, of course, be communicated to me.

THOMAS TELFORD.

Chester, 27th November, 1823.

HAVING examined the river channel at low water, I beg leave to report, that since my last inspection, both the old and newly extended rubble stone dykes have been regularly attended to, preserving their tops at a proper height above the constantly accumulating sand banks, and that the effect of these dykes and banks has been to force the low-water river channel towards the Flint shore, nearly to the utmost extent that is desirable.

Under these circumstances, I am of opinion that, at present, the chief object should be to continue to raise the rubble dykes very cautiously, as the sand banks accumulate, but not attempt any further extension of length.

Upon the whole, the progress of the river improvement, as regards navigation, seems to have proceeded with all the success that could either have been expected or wished.

THOMAS TELFORD.

Nantwich, 27th July, 1826.

HAVING carefully examined the river Dee from the Sluice House, at Chester, to the extremity of the new causeway, below Connah's Quay, at low-water mark, on the 23rd instant, being the fourth day of the spring tide.

I found the whole channel of the river in a regular state, and excepting its only bend at Sloop Bridge Sluice, and at another place where a vessel had been aground, I did not, even at that state of the tide, observe a sand bank.

The above-mentioned exceptions are unavoidable, and will always vary according to circumstances.

The new causeway of about 1000 yards in length has, during the last and present season, agreeably to my directions, been completed and strengthened by means of about 19,000 tons of rubble stone. It is now in a very perfect state, and has effectually succeeded in changing the crooked channel which formerly traversed the sands towards Park Gate, and directed it towards the Flint shore; so much so, that besides the channel which passes along the new causeway, a still more direct course is now found close along the shore in nearly a straight line between Connah's Quay and the town of Flint; down which about one-half of the water passes at low water, and which may, in a short time, be expected to become the main channel, the accomplishing of which has been the principal object in view.

That the outfall of the river has been greatly improved is evident, from the surface of low water being now about three feet below fixed sills at the lower ferry, &c., and that the channel, for the whole distance to Chester being, at the time of my inspection (with the before-mentioned exceptions), clear of sand banks, and even if occasional sand banks may appear, these, instead of proving that the channel is choking up, are chiefly rendered apparent from the outfall being improved and permitting the water to ebb so much lower than formerly.

Under all the circumstances here detailed, I consider that it would be injudicious to attempt to extend the new causeway at present. It is more advisable to be satisfied with maintaining it in its present perfect state, until it has been seen what effect the joint operations of the tides and river floods will have in completing the new and direct channel along the Flint shore.

So that upon the whole, what I at present advise is, to continue to preserve the present old and new causeways in a perfect state; to keep in repair the numerous groins along the embanked channel, and occasionally add to the length of such, as observation and experience shall prove to be necessary.

THOMAS TELFORD.

Chester, 23rd July, 1828.

ON the 21st I passed down the river Dee in a boat, at a little distance before low water, and took soundings all the way from opposite the canal entrance to the town of Flint.

Through the whole of this distance the bottom is generally uniform, with only two slight exceptions, where the water was somewhat shallower. The first is above the upper bend of the river at Sloop Hole Sluice, where a groin requires to be lengthened. The other is a little way below the lower ferry, where I recommend that an additional groin be constructed.

In my report of July, 1826, I stated that the groins should be repaired and lengthened, as experience should show to be necessary. That has been carefully done, and the whole of them (as well as the north bank) are now in a good state.

Below Connah's Quay the main channel of the river now passes in nearly a direct line from the termination of the new causeway to the town of Flint. The object for which this causeway of 1000 yards in length was constructed having been completely obtained, I am of opinion that no useful purpose can be accomplished by any attempt at a further extension of a mound, now 30 feet in height, and having 22 feet of water at its termination at low water.

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No. 167.
Telford, on the Navigation of the River.

Since my last report, the above-mentioned causeway has been repaired and strengthened by means of upwards of 4000 tons of rubble stones, and a continuation of similar attention is necessary.

I have nothing further to observe respecting the navigation of this river, which appears to have been maintained uniform and regular since my said last report in July, 1826, and is, in my opinion, at present in as perfect a state as it is capable of.

During the last two months, I have examined and reported upon four navigable rivers, viz., the Dee, at Aberdeen, the Tay, at Dundee, the Forth, between Leith and the opposite coast of Fife, and the river Clyde below Glasgow.

In every river there are local peculiarities, but the last mentioned, viz., the Clyde, and the river Dee, at Chester, bear the greatest resemblance in regard to their navigable length, the dimensions and shape of their estuaries, and the means which have been employed to acquire and maintain a proper depth of water in their upper portions.

The Clyde has not yet been rendered so perfect as the "Dee," but similar means are still employed to render it so; and there has now been obtained from 11 to 12 feet at good spring tides; but, with a navigation which is evidently inferior to that of the "Dee," there is now produced a revenue of 18,000*l.* a-year.

THOMAS TELFORD.

No. 168.

The Report of Sir J. RENNIE *on the importance of the River Dee, and Port and Harbour of Chester.*

No. 168.
Rennie, on the River Dee and Port of Chester.

GENTLEMEN, *London, July 27th*, 1837.

IN consequence of your resolution of the 24th of January last, requesting me "at my earliest convenience, to make a survey of the capabilities of the port and harbour of Chester, with a view to the improvement of the River Dee, and the formation of Wet Docks," I accordingly lost no time in attending to the subject; but, as no satisfactory opinion could be formed without, in the first instance, having a correct chart of the river, with all the necessary levels and soundings; and as I could not procure any one sufficiently detailed and accurate for my purpose, I sent Mr. Rennington, one of my assistants, as early as the season would permit, to make the necessary survey; and as it was impossible to complete the various details required by his instructions until the 14th ultimo, I deferred my second visit until then, when I personally examined the river from Chester to the outer bar, and left Mr. Rennington to complete the survey, which was only accomplished on the 26th ultimo, when he returned to London with the necessary documents.

I will now proceed to describe the result of my investigation as concisely as possible; but as the subject comprehends such a variety of interesting and important questions, in order to render the whole more clear, I will divide it into the following heads:—

First.—The history of the River Dee, and the various works which have been executed, and are now in progress, with their effects upon the river and port of Chester.

Secondly.—The actual state of the River Dee, and its navigation.

Thirdly.—The capabilities of the river, and the best mode of improving the navigation, so as to bring large vessels up to the city of Chester, together with an estimate of the expense.

Fourthly.—The advantages of the proposed improvements, considered with reference to the probable returns and effects on the trade of the surrounding populous and manufacturing districts.

With regard to the first. The Dee is the principal river in Cheshire, and takes its rise in the lake of Bala, in Merionethshire, North Wales; and after pursuing a northerly and north-westerly course, passing by the towns of Corwen, Llangollen, Overton, Holt, Worthenbury, Malpas, and receiving the the Alyn and several other tributary streams, reaches Chester, after a course of about 50 miles; at a short distance below which city it enters a capacious estuary, about 24 miles long, and four to six miles broad, and joins the Irish Sea, bounded by the Point of Ayr on the south, and Hilbre Island on the north. This river, like all others, is subject to floods; but, inasmuch as it passes for the most part of its course through mountainous country, the floods are necessarily more frequent and sudden, and at times increase to such an extent as almost to impede entirely the passage of the current of the flood-tide. From the rapid and unequal fall of the river throughout the greatest part of its course, and its frequent interruption by cascades and rapids, it is for the most part unfit for navigation (with the exception of some of the intermediate still pools) until it reaches Chester, and serves chiefly for the discharge of the draining waters of the country, and for working mills, for which purpose weirs have been erected in various places. Before proceeding further, it will be highly curious and interesting to refer back to the history of the port.

The peculiar advantages of the situation of Chester attracted notice in the earliest periods of British history. The Romans made it one of their principal stations, so that, to use the words of an early writer,* "it was made the receptacle of merchandise from all kingdoms and nations who traded into the British or Irish Ocean, and become the very key or inlet whereby not only the Romans, in their time, made their passage to and from Ireland, and the other western and northern islands, but all other kings and princes upon all needful occasions." Chester continued to increase in importance, and became the capital of this part of the kingdom, and at times a royal residence. In consequence, however, of the inefficient state of the port, its prosperity began to decline; for, as far back as the reign of Henry VI., it had become so inadequate to the trade, that it was necessary to construct a quay at Shotwick, about six miles below Chester, where large vessels discharged their cargoes, and sent them in lighters to Chester, and in like manner received their ladings in return. Still, however, the prosperity of the port continued to decline; and during the reign of Elizabeth, a new haven or quay was constructed lower down, at Parkgate, which took its origin from thence, and became the principal port of communication with Ireland.

The distance of Parkgate (12 miles) from Chester, and the inconvenience and expense occasioned thereby, at length roused the attention of the public; and, in 1674, Mr. Andrew Yarranton, well known by his book on "England's Improvements by Sea and Land," took a survey of the River Dee and its estuary, and formed the project "of a new channel, and for recovering from the sea a large tract of valuable land, and for restoring the ancient navigation, even to the quays at Chester, which

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* *See* Ormerod's History of Cheshire.

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was presented to the Duke of York, at that time the patron of all great undertakings. An Act of Parliament was accordingly obtained for the recovering and preserving the navigation of the river; for settling duties on ships, and for establishing two ferries, for the convenience of travellers, into the county of Flint. Other Acts were subsequently obtained in the years 1732, 1740, 1743, and 1752, and the works were begun with vigour. The project was carried on by subscription, and the adventurers were to be rewarded by the lands they were empowered to gain on both sides, from the white sands on the sea below Chester and between the county of Chester on the north side, and the county of Flint on the south side, being sands—soil not bearing grass. The expenses proved enormous; multitudes were obliged to sell out at nearly 90 per cent. loss; at length the plan was brought to a considerable degree of utility, and a fine canal formed and guarded by vast banks, in which the river is confined for the space of 10 miles, along which ships of 350 tons burthen may be safely brought up to the quays." The misfortune of Chester about this time gave rise to the prosperity of Liverpool, then a very inconsiderable place, which henceforth increased in importance until now, when it forms, as it were, the grand capital and emporium of trade of the north of England. The works for the improvement of the Dee and port of Chester, as sanctioned by the foregoing and subsequent Acts, have proceeded with more or less vigour ever since. The last work of any importance was the extension of the Rubble Embankment, from near Connah's Quay to about half a mile lower down, which took place about fifteen years ago. Since then, I understand, little has been done, except placing a few jetties here and there between Chester and Flint, in order to confine the current and increase the scour. The Dee Company, I believe, originally agreed, or rather engaged, to maintain 16 feet always at high water of ordinary spring tides, at Wilcox Point, Chester. This was subsequently altered to 15 feet; and accordingly a gauge, or standard, has been erected for that purpose, near the entrance of the Ellesmere Canal. It appears, however, that they have not been able to maintain above 14 feet, or 14 feet 6 inches. The total quantity of land embanked from the estuary is upwards of 4,000 acres (besides a large tract of unenclosed salt grass), which is now under tillage, and is very valuable.

The effects of the works above-mentioned has, I am informed, been to increase the depth of water between Flint and Chester, and to enable larger vessels to come to Chester than previously. From thence, however, downwards towards the Point of Ayr, it does not appear that any particular improvement has taken place; on the contrary, the great flats off Bagillt and Parkgate have materially increased, and the low-water channels at these places have suffered in proportion, particularly at the latter place; for where there used to be 18 feet at low water, there is now an extensive shoal, extending almost across the estuary at low water, so that it is unfit for vessels or boats of the smallest class; whereas, formerly, it used to be one of the principal stations for the packets between England and Ireland. One of the chief causes of this was, no doubt, the diversion of the channel from its natural course on the Cheshire to the Flint shore. Had the channel been continued there, and proper means been taken, the depth at Parkgate would have been increased rather than have diminished. The Company must have had some reason, which does not appear, for adopting this course. It is quite clear, however, that as far as the river is concerned, the measure was not quite so complete as it might have been; for not only is the course lengthened nearly five miles, but four most inconvenient angles or bends are produced, which add materially to the friction and consequent impediment of the scour of the waters, both tidal and fresh. But inasmuch as the main set of the flood-tide coming from the Irish Channel naturally sets on the Cheshire shore, and on the ebb takes the same channel, although in an opposite direction, and under present circumstances each of them must bend back again almost at right angles before it can enter or leave the new channel, which is on the opposite or Welsh shore: thus, a further most serious obstruction to the tidal and fresh waters is created; and, moreover, as the preservation of the sectional areas of all channels depends on the quantity of water passing through them, that it may reasonably be inferred, that the channels below Flint and Parkgate have suffered to a certain extent, in consequence of the abstraction of a large quantity of tidal water by the embankment of 4,000 acres above-mentioned from the estuary, and over which the tide used formerly to flow, although the new channel between Flint and Chester may be said to have improved. Upon the whole, therefore, it may be inferred, that although the measures undertaken according to the Acts above-mentioned have not been altogether so judicious as they might have been, nevertheless vessels of a larger class than previously are able to reach Chester at spring tides; but the navigation is still far from being what it ought to be, or is capable of being made.

With regard to the second. I will now proceed to describe more in detail the actual state of the river. From the survey of Mr. Rennington, it appears that an extreme neap tide only rises 2 feet 9 inches at Chester Bridge; 3f. 7in. at the Ellesmere Canal Lock; 6f. 9in. at King's Ferry; 10f. 11in. at Flint; and 11f. 4in. at the Point of Ayr. Thus showing a greater rise of 8f. 2in. at Flint than at Chester Bridge, and 8f. 7in. greater at the Point of Ayr, 24 miles distant. The object of giving an extreme neap-tide is to show the defect of the navigation, as regards taking large vessels to Chester. The depth at low water at neaps and springs is nearly the same between Chester and Flint; but from thence to the Outer Bar, there is a material difference, there being a much greater depth at low water of neaps than of springs, in consequence of the tide not ebbing so low. Again, the rise of spring tides is 13f. 8in. at Chester New Bridge; at Ellesmere Canal Entrance, 14f. 8in.; King's Ferry, 17f. 6in.; Flint, 23f. 11in.; Point of Ayr, 29f. 6in. Thus showing a greater rise at the Point of Ayr of 15f. 10in., and 10f. 3in. at Flint than at Chester Bridge. The proportion of the above will, no doubt, be materially affected by different winds and freshes: for example, southerly and westerly winds produce the highest tides, and *vice versâ*, northerly and easterly winds cause the lowest ebbs. When there is no fresh in the river, still, however, the difference in the rise of tide at the respective places above-mentioned generally bears about the same proportion, uninfluenced by these circumstances. Again, the greatest depth at low water at Chester Bridge varies from 6 to 7 feet; but from thence to the Ellesmere Canal Entrance, 2 to 6 feet; from thence to the King's Ferry, from 1f. 6in. to 4 feet; thence to the end of the Rubble Embankment, from 4 to 5 feet; thence to Flint, 1f. 6in. to 2f. 6in.; thence over Bagillt Bar, from 1 to 2 feet; from thence to Chester Bar, 19 to 48 feet; and upon the Bar, 12 feet at springs, and 20 at neaps; and in Hilbre Gap, 11 feet at springs and 19 feet at neaps.

The area of the sections of the river at the following places is:—

	Low water.	Tidal.	Total.
Chester Bridge	1,128	2,760	3,880
Ellesmere Canal	1,720	4,039	5,760
King's Ferry	900	5,808	6,798
Rubble Embankment	3,465	82,801	86,866

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Again, it is high water at the Point of Ayr 15 minutes before at Flint; 20 minutes before at King's Ferry; 26 before at Ellesmere Canal Entrance; and 30 before Chester Bridge.

Upon comparing the charts of the River Mersey and the Dee by Messrs. Evans and Denham, it appears that it is high water at the Point of Ayr 10 minutes earlier than at Formby; and 30 minutes earlier at Formby than at Liverpool. Therefore, as the difference between the Point of Ayr and Chester is only 30 minutes, it follows that it is high water there 10 minutes earlier than at Liverpool; and when it is considered that the Point of Ayr is situated 14 miles nearer to the Atlantic than Formby, and that the great strength of the ebb tide coming out of the Mersey must check the flood there is every reason to believe that this is not overstated.

High water mark of spring tides at Chester Bridge is rather higher than at the Point of Ayr, forming nearly a regular inclined plane between the two places; but at neaps the two marks are nearly level: this is no doubt occasioned by the backing up of the fresh water, combined with that of the tides.

The average velocity of the flood current of spring tides is four miles per hour, between the Point of Ayr and the entrance of the new channel; from thence to Chester it is six to seven miles per hour; at neaps between the Point of Ayr and the new channel, the velocity is about one and a half miles, and from thence to Chester, two miles. Immediately above the old bridge at Chester, the dam or causeway for the purpose of supplying water power for the Dee Mills is situated. "This dam was erected by the Earl of Chester, Hugh Lupus, who also made a diversion in the course of the river, and brought it nearer to the town previous to the Conquest. Henry III. becoming Earl of Chester, the mills reverted to the crown, and were attached to it until Edward VI, and in the sixth year of that reign, they were granted in fee to Sir Richard Cotton, and subsequently to his son, who again let them at 100*l*. per annum to Edmund Gamul, who afterwards expended 4000*l* on the repairs of the dam or causeway—a considerable sum in any case, and more particularly so at that early period. In the following century (17th) the dam or causeway became a subject of much litigation, in consequence of its supposed prejudicial effects on the river, by its preventing the free access and discharge of the tidal and upland waters, and thus preventing them from cleansing and scouring the harbour from the accumulating sands."* It does not appear whether any alteration was made in the weir or causeway in consequence of the above litigation; whether it occurred or not, the weir or causeway still exists, and is now united in one proprietor. The history of these works is highly curious and interesting, as it serves to illustrate the views taken in this department of civil engineering at that early period; also as an epoch from whence may be dated any alteration in the river below. Spring tides now pass over this weir, to the height of four feet, during which period the operation of the mills necessarily ceases: the same takes place during fresh water floods to a certain extent.

From the above description of the river, it is evident that the navigation is in a very defective state, and with the exception of a very short period at the height of spring tides, vessels drawing above six or seven feet water cannot reach Chester. The navigation may be divided into three parts. The first commences at the Outer Bar, situated four miles to the south of the Point of Ayr, opposite to Prestatyn, and is close to the shore: this channel bears E. and W. and is bounded on the sea side by the great bank of West Hoyle. At low water of spring tides, it varies from about two miles to one mile in width, having 12 feet over the Bar, and increases to 24 and 72 feet at the Point of Ayr; from thence it is divided into two channels by the Salisbury Bank, having a general bearing of N.W. and S.E., the north channel leading to Dawpool, and the south by the Wild Road to the Welsh Channel. The former bears S.E. and continues to Dawpool, varying from 24 to six feet at low water of springs, and the latter bearing S.E. by S. varying from 48 to 19 feet at low water of springs, until it reaches Bagillt Flats, where there are seven feet and two feet over the bar. There is also another channel bearing N. and S., called Helbre Swashway, which communicates with the Mersey, and forms the northern entrance to the Dee, having 11 feet at low water of springs over its bar, when it communicates with the Mersey Channel. The distance from Dawpool to the Point of Ayr is six miles, and from thence to the Outer Bar four miles further, or ten miles from Dawpool. The distance of Bagillt Bar to the point of Ayr is seven and a half miles, and 11½ miles from the Outer Bar. The second division extends from Dawpool and Bagillt Flats to Connah's Quay, a distance of 11 miles from the former, and eight and a half from the latter; upon leaving Dawpool it is half a mile wide, 23 feet deep, bearing S. and by E.; from Bagillt Flats to Flint, it bears S.W., and decreases from one mile to 100 yards wide, and from 23 feet to three feet deep; from thence to Connah's Quay, it first bears E. for two miles, then S. for two miles, and decreases from three to two feet deep, with a width of about 80 yards at low water. The third division extends to Chester, a distance of eight and a half miles, bearing S.E. for six miles, and E. for a mile and a half, and one mile S. by E. varying from one foot six inches to five feet deep, and 90 to 120 yards wide at low water. Taking, therefore, the first division, a vessel drawing 11 feet water, or 220 tons, could experience no difficulty in crossing the Outer Bar at low water springs, and by the time she arrives at the entrance to Dawpool, would scarcely meet with any detention, and even here, in the course of a very short time, the rapid rise of the tide would enable her to enter Dawpool. From thence, in the second division, she would reach Flint as fast as the tide would carry her, as there would be sufficient depth of water; but from thence upwards, a distance of 13 miles by the river, she would scarcely be able to reach Chester the same tide, as the flood would be spent before she could arrive there, and be compelled not only to drop anchor, but take the ground and wait for the next tide. Vessels drawing 14 or 15 feet would only be detained a very small portion of the first quarter of the flood before they could pass the Outer Bar, and the first quarter flood before they could cross into Dawpool, and could easily reach Flint; but here the difficulty and delay begins, for except at extraordinary spring tides, there is scarcely sufficient depth over the shoals and at Chester at high water to enable vessels of this class to come at all, even when assisted by the most favourable circumstances, and by a powerful steam boat, and where they are liable to be detained for many weeks before they can return; so that the navigation between Flint and Chester cannot be termed fit for vessels drawing above 13 feet at spring tides, and then are subject to considerable detention during the period of neaps. At neaps, however, there is plenty of water over the Outer Bar and entrance to Dawpool, so that vessels drawing above 14 feet could pass without difficulty. But as the tide only rises from three to four feet during neaps, as far as Chester, and there is only four feet at low water in the channel, the navigation is not practicable for vessels drawing above seven feet, and with the exception of four or five vessels of 250 tons burthen, belonging to the cheese company, who have a steam boat to tow them up and down the river during spring tides, all the trade of Chester is transported in small crafts of about 70 tons burthen, so that, in fact, it has dwindled away to comparatively of little importance.

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* *See* Ormerod's History of Cheshire.

In consequence of the uncertainty and defective state of the port, the extensive trade which would otherwise have passed through Chester, as the natural channel of communication with the ocean, and from thence to various parts of the world, has found out other channels, such as Liverpool, where it at present finds superior accommodation, and is duly appreciated. Liverpool has therefore become the general emporium of trade of the north-west of England, and facilities of every kind by way of docks, railways, and canals, are continually multiplied around it on all directions, to the detriment of Chester, so as to leave it without a rival.

Having, I trust, above fully described the present defective state of the River Dee and its navigation, and the causes of the same, I will now proceed to the third division of the subject, in order to ascertain how far the present evils are capable of being remedied, and whether it be possible to restore the trade of the city of Chester to that importance which it once held, and which its commanding situation in the midst of a populous and fertile district entitles it still to hold. The principal defects of the present navigation exist, as has already been remarked, between Chester and the town of Flint; for while vessels drawing 15 feet can almost always reach the latter place at high water of neap tides, vessels drawing only 12 and 13 feet can scarcely reach Chester even at spring tides, and then only with considerable care and attention, and at the risk of being neaped, and then delayed several weeks; in order, however, to enable them to come up to Chester at neap tides, it would be requisite that there should be an additional depth of from nine to ten feet.

There are two modes by which this might probably be effected, either by lowering the bed of the upper part of the present river channel, so as to give a corresponding depth of water, namely, 13 feet at low water, which, together with the rise of tide, would always give 16 feet; or else to prolong the channel direct to Flint, and to place a weir and lock of sufficient capacity at its lower end, by which means the present river would be converted into a canal. The first plan would be very expensive; all the slopes of the present banks would require to be reformed and strengthened, in order to prevent them from being undermined; and after the necessary depth should have been once obtained, it would require considerable expense and continual dredging to maintain it, which would be difficult and uncertain, and would occupy a long time before it could be completed, and even then the difficulties of the navigation below Flint, occasioned by the Bagillt Flats, would still have to be encountered. It may be here observed, that this latter objection might be obviated by extending the new channel along the Welsh shore to the Point of Ayr; this also might be accomplished at considerable cost and time; but as the natural set of the flood and ebb is upon the northern or Cheshire shore, and the mouth of the new channel being on the south shore or Welsh, there would be a continual conflict of currents at the entrance of the new channel, so that it would be difficult to enter or leave, and the tide upon the flood and ebb would be materially checked, and in the event of more land being embanked from the estuary, the lower or sea channel would be materially affected. Indeed, it would be extremely difficult to predict the consequences of such a measure, but which I have no doubt would be very injurious. A work of this kind, in order to prove beneficial, should be constructed on the northern or Cheshire shore of the estuary; this, however, would render it necessary to leave the south shore entirely, and then all the establishments situated along the banks of the present river would be abandoned, which would not probably be permitted.

The idea of converting the present tidal channel of the river into a canal, without making another channel for the tidal and fresh water, would be extremely unadvisable, for without a tidal channel, it would be almost impracticable to provide for the drainage of the interior country; and the abstraction of so large a portion or rather receptacle for tidal water from the present river, without replacing it by an equivalent area, would certainly have a very prejudicial effect upon the estuary below the canal, and tend materially to reduce the depth in the various channels approaching to it. Under all these circumstances, I am clearly of opinion that it would neither be advisable to convert the present river channel into a canal, or to attempt to increase its depth sufficiently so as to enable the desired class of vessels to approach Chester at neaps, or at high water of all tides. The next question to be considered is, what is the most advisable plan for attaining this most important and desirable object; and here it may be observed, that having found that the plan of converting the present channel into a canal, or making it sufficiently deep, was not advisable, I then turned my attention towards the northern shore; and after maturely considering all the different circumstances, I am of opinion that a ship canal, commencing near Heswell, with communicating bridges, and terminating at Chester, with floating docks, near the basin of the Ellesmere Canal, will be found most eligible. The dimensions of such a canal will naturally depend upon the size and class of vessels required to be transported; unless, however, it be constructed upon a sufficiently large scale, it would not be adequate to the object in view, namely, making Chester a port for large vessels. For this reason, therefore, I think it ought to have not less than 18 or 20 feet water, so as to admit vessels of 600 to 700 tons, and to be wide enough to enable steam vessels to use their machinery without injury to the banks of the canal. The entrance lock should be near Heswell, with a tide basin or outer harbour in 15 feet at low water of spring tides, which would serve to facilitate the entrance and departure of vessels from the locks. The canal should terminate in a basin of corresponding magnitude, and the same depth as the canal at Chester, and should be made to communicate with the present Ellesmere Canal and the old river. It would be also highly desirable (and would probably take place as a natural consequence, in the event of the canal from Heswell being completed) to make a branch from the Ellesmere Canal, to join the Duke of Bridgewater's Canal near Preston Brook, which would complete the water communication with Manchester, and from thence all over the kingdom, and save the present inconvenient navigation of the Mersey from Runcorn to Liverpool, by which great delay and expense are incurred. A small branch railway should be made from the proposed Chester and Crewe Railway, which would at once complete the communication with Liverpool, Manchester, Birmingham, London, and the surrounding towns, which have either railways already in operation or in progress, so that by this means Chester would be enabled to derive the full advantage of all these additional improved means of conveyance. The total length of this ship canal would be about twelve miles; and the levels and line of country are extremely favourable. The entrance lock would be founded in fine red clay, of which plenty may be obtained for puddling the canal, in the event of being found necessary. The probable estimate for completing it, including the entrance harbour at Dawpool and basin at Chester, would amount to the sum of 560,000*l*. It would be easy to design works of less magnitude, either for a canal or the old river, if the above should be considered upon too great a scale, and for which estimates can be prepared, if desired; although, if the great undertaking can be accomplished, it would be

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far preferable. The above sum, although large, is moderate when compared with the great object to be obtained; and when it is considered that the railway from Chester to Birkenhead is, I understand, estimated at 250,000*l.*, without any docks, which may probably be taken at 100,000*l.* more, and this for the object of taking the trade away from Chester as a sea port, and converting it into a mere inland station, it cannot for a moment be doubted but that the canal has decidedly the advantage; and it is the interest of the city of Chester, and of the surrounding populous mineral and manufacturing country, to give it their most strenuous support. The railway, no doubt, as far as passengers are concerned, would be a great convenience; but for the transport of goods, including the cost of extra loading and unloading for export and import, would greatly exceed the cost by the ship canal. The advantage also over the present river navigation would be very considerable; for, instead of being 17½ miles long, and only adapted for bringing up vessels drawing 14 feet at springs, the distance would only be 12 miles, and there would be no difficulty at all times after the first quarter flood to last quarter ebb (or eight hours), to bring up vessels drawing 19 to 20 feet to Chester, within two hours after entering the lower lock. The present river channel should still, however, remain open for the navigation of small craft and for the discharge of the drainage waters, and thus double advantage would be obtained. The supply of water to the canal might be obtained from the tide, or the waste lockage from the Ellesmere Canal, or by a feeder from the Dee above Chester, which, in case it might at times during dry seasons interfere with the Dee Mills, would be made good by a steam engine. It is satisfactory to know, that the idea of forming a ship canal in this direction is not new. It was entertained by me in 1825, and subsequently by the late Mr. Chapman in the same year, who wrote an able report on the subject, with a view of extending it to Manchester, and making that important town a sea port. Such an extensive undertaking, however, is unnecessary, as the country, for the most part, is already occupied by several excellent canals, such as the Duke of Bridgewater's, the Grand Trunk, the Mersey and Irwell, and others, and as the same object would be in a great measure obtained by merely extending the Duke's Canal to Chester, as before mentioned. Mr. Chapman, however, has completely proved the practicability of such an undertaking, and established the importance of making the Dee an additional outlet for the importation and exportation of the trade and manufactures of this part of the country. In carrying into effect the Chester Ship Canal above recommended, it would be extremely desirable that the River Dee Company and the promoters of the Canal should be united together, having one common interest, and as the canal would give accommodation to the largest class of vessels without interfering with the present river navigation, it would be unnecessary to expend more money upon the present river channel. As a further confirmation of the superiority of the Dee, the late Messrs. Telford and Nimmo made a survey and report, in order to make a new entrance to the Mersey from Dawpool, which was very favourable. All further proceedings, however, in this undertaking, were suspended; but the Corporation of Liverpool purchased up all the intervening property.

With regard to the fourth. In order to ascertain how far such an undertaking would be likely to produce a profitable return for the capital required for its completion, it will be proper to institute a comparison between the two entrances of the Mersey and the Dee, as well as the population, manufactures, and trade of the surrounding districts. The Mersey is only accessible from seaward by two entrances: the outer one, called the Formby Channel, is about three miles from the Lancashire, and six and a half from the Cheshire coasts; it is nearly half a mile wide, and has 12 feet at low water of springs, according to Captain Denham's chart. This channel, however, is surrounded on all sides by dangerous banks, and is only approachable in clear weather for large vessels at one quarter to half flood; from thence to the floating light, distant about seven miles, the navigation is dangerous, and requires the greatest care and skill. The Inner or Rock Channel is situated close to the Cheshire shore, and forms, as it were, a mere gut, and is almost dry at low water. This channel, although by no means so deep as the other, nevertheless, upon the whole, has been preferred until lately, as being more certain and secure; although vessels are necessarily detained longer, as they cannot pass the shoals until the flood tide has considerably advanced. The course from this channel outwards to the floating light is equally difficult, and requires equal care as the former. The Mersey within these channels forms a fine capacious harbour with plenty of water, although the great strength of the tide, occasioned by the disproportionate contraction of its mouth to the extensive estuary within, combined with the immense number of vessels of all descriptions frequenting Liverpool, and continually in motion, renders it both difficult and dangerous to be in the channel, and consequently they get out of the tide-way as soon as possible into the docks, which are upon a magnificent scale, provided with conveniences of every description ready to receive them.

The entrance to the Dee commences at Chester Bar or Flats, 27 miles below Chester, and about 12 miles to the westward of the Black Rock Light-house, or entrance to the Mersey. The south channel across the bar is a mile wide, and has 12 feet at low water of spring tides; the northern entrance commences at Helbre Gap; but between these two entrances and Dawpool, there is another bar, with only six feet at low water of spring tides: but, as when vessels have passed the lower bar and have reached the entrance to Dawpool, they can be afloat at all times and ride in security, this inner bar, although to a certain extent inconvenient, is not of so much importance. The outer bar of the Dee is certainly much safer to approach than that of the Mersey; and when once vessels outward bound have passed it, they are clear of all sands, and can continue their voyage without danger or difficulty. Vessels coming from or proceeding northward have nearly similar advantages by Helbre Gap; so that, as regards depth of water and facilities of approaching and departing, the River Dee certainly possesses equal (if not superior) advantages to the Mersey.

With regard to the maintenance and stability of the channels in their present state, I see no reason to anticipate any material alteration: for although they may vary a little, more or less, according to the prevalence of particular winds and freshes, nevertheless the same means of preservation will continue; and as I understand they are better now than lately, it is by no means improbable but that by judicious measures they may be improved.

I now come to the last important consideration, namely, the probable return for the capital proposed to be expended in completing the works above recommended. This, no doubt, embraces a great variety of local points, which you are better enabled to form an opinion upon than I can possibly be; nevertheless, there can be no difficulty in coming to some general conclusions, leaving the remainder to be supplied by yourselves. Assuming Chester as a central point, it is 16 miles nearer to London than Liverpool; and taking a radius of 34 miles, it will be seen that it includes Manchester and Warrington, and which are within two to three miles as near to it as Liverpool, whilst Macclesfield, Congleton, the Potteries, Northwich, Middlewich, Nantwich, Tarporley, and a number of lesser towns, are con-

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siderably nearer. The whole of the extensive mining and manufacturing districts of North Wales are in the immediate vicinity of Chester: but from the force of circumstances, such as the superior enterprise and artificial conveniences of Liverpool, they are necessarily compelled to adopt that port instead of Chester, which is their natural outlet, and submit to all the extra expense and delay of transporting their exports and imports thither, occasioned by the additional distance. And consequently, in this emporium of the trade of the north, all the communications by way of railways, canals, &c., have concentrated thither, leaving Chester almost wholly abandoned, although its natural advantages as a port, combined with the above improvements, and proximity to a populous and manufacturing district, would render it in many respects equal, if not superior. If, therefore, the same spirit of enterprise was exhibited in promoting accommodation for trade, there can be no reason to doubt but that it would not only again revive, but increase, and that Chester would participate in the advantages enjoyed by Liverpool.

Upon the whole, therefore, taking all these circumstances into consideration, I am of opinion that by the adoption of the measures above recommended, the trade would derive that accommodation which it requires, and for want of which it has abandoned Chester. It may, consequently, be reasonably inferred, that a profitable return would be derived from the capital expended in carrying them into effect, particularly with the examples of Liverpool, (where, I understand, only 50 years back the income from the Docks scarcely exceeded 2,000*l.* per annum, and it is now above 200,000*l.*); also the Gloucester and Berkeley Canal, and other similar works. As soon as additional facilities for commerce shall have been provided at Chester, new establishments would arise, additional capital would be created, and Chester would regain its lost position in this part of the kingdom; whereas, if the opportunity be delayed much longer, new projects for other places will arise, and the great additional capital which will be expended on them and in communicating with the Mersey, will create fresh and powerful interests, which it will be more difficult to overcome, and the obstacles against improving and rendering the port of Chester what it is capable of being made will be greatly increased.

I am, &c.,

John Rennie.

To the Committee appointed to consider of the best mode of improving the Port of Chester.

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No. 169.

Letter on the Improvement of the River Dee, and Port and Harbour of Chester. By J. Scott Russell, Esq., M.A., F.R.S.

My dear Sir,

Edinburgh, Nov. 7th, 1838.

It seems to me that the most satisfactory way of replying to yours of the 20th October will be to give a rapid sketch of the ground I went over with the Committee for the improvement of the Navigation to the city of Chester, when they requested my opinion in 1837, especially as all I have since learned upon that subject has convinced me of the accuracy of the opinion I then stated.

It is well known to those who reside in the basin of the River Dee, that its present channel, from the city of Chester towards Flint, is an artificial canal, of gigantic dimensions, originally excavated by a company at very large expense, in return for which they received the property they were able to reclaim from the former bed of the river. This magnificent tidal canal extends nearly in a straight line from Chester to Flint, and has for a series of years been gradually deepened by the waters of the river, so that now there is a depth of 14 feet at high water of ordinary spring tides. The natural process of excavation by means of the waters of the river is now, however, nearly at an end, and additional means have become necessary in order to obtain the additional depth that is desirable.

In these circumstances, your Committee took the necessary steps to ascertain the most desirable course of proceeding, and ordered a survey of the capabilities of the port and harbour of Chester, with a view to the improvement of the river, &c., and they were informed in reply, that the best thing they could do would be to abandon altogether the present channel of the river, leaving it as a mere drain for the waters of the country, and go back to the former bed of the river, forming a totally new canal, at an expense of not less than 560,000*l.*, exclusive of the purchase of land, &c., which canal should enter the river at Heswell, on the Parkgate side, by means of a lock. This, they were told, is the only advisable course for the inhabitants of Chester.

Now, Sir, every one who looks at the state of the ports of Liverpool and Chester knows that the expenditure of such a sum of money, even if successful in obtaining its object, would never prove remunerative. One of the sanguine advocates of the scheme states, in a letter to the public, that on the supposition that Chester shall at once take half the trade from Liverpool by this new channel, the proprietors may obtain 12 per cent. for their money. But even if we suppose his estimate of expenses to be correct, which is very far indeed from being the case, it must still be obvious that the trade of the country cannot make an instantaneous migration from one place to another; that, on the contrary, many years must elapse before all the facilities of a commercial town can be congregated at Chester; and that a gradual growth and steady increase of Chester, as a commercial port, is the utmost that can be expected or even desired by its warmest friends. In the mean time, the instant expenditure of a sum which would not in reality amount to less than a million of money, would load the undertaking with an unremunerative debt that would essentially cramp the energies of the most enterprising spirit of speculation, and long before the flood of commerce had set strongly on Chester, this debt would have at least doubled. A large immediate expenditure of unfructifying capital, with a load of debt, and a distant contingence of trade, is all that is thus held out to the citizens of Chester by this extraordinary canal project.

Sir, I have no hesitation in repeating the statement which I formerly made to your Committee, that I do not think the well wishers of Chester are driven to this extremity, or that it is their interest to resort to such an expedient. I think the means of gradually, prudently, and profitably increasing the prosperity of the port are very simple, and quite within their reach. I think that the present magnificent canal which they already possess should be improved—not abandoned, and that one method alone can be adopted consistently with the interests of all parties concerned.

At this particular moment I think it of peculiar importance that the best interests of Chester should be carefully examined, and properly understood. The progress of improvement is at present most auspicious for Chester. The various lines of railway that are projected, will connect it

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directly with a great extent of country, and a dense population towards the south, and with Liverpool on the north; while a new line of canal, which is to be carried through under the direction of Mr. Provis, will shorten the distance of the port of Chester from Manchester by 18 miles. This canal is to connect the Chester and Middlewich Branch with the Duke of Bridgewater's, near Altringham. Chester will thus become a suitable port for a part of the trade of Manchester, Birmingham, Shrewsbury, Ellesmere, Staffordshire, and Lancashire, and North Wales.

In such circumstances as these it would be a matter of deep regret if Chester had no better mode of procedure than the ruinous one of abandoning her present channels of communication with the sea, and opening up anew her former line of communication by such means as the canal already alluded to.

We now come to the great question, What is the best method of effectually improving the great canal of the River Dee, and the channel at the mouth of the estuary below it?

There are two ways of deepening the bed of a river: one is to contract it, and so direct the stream as to excavate by the current of the river a bed for itself. This process, which may be termed the first process, soon attains its limit. The bed assumes a uniform slope due to the velocity of the current, and the natural process is at an end.

The second, and comparatively modern method, is by steam dredging. It is only of late years that the gigantic powers of the steam engine have been applied to this species of labour. No one who has not seen the extensive use made of these powerful machines can have any idea of the efficiency of that labour. It is a remarkable fact, that the work of excavation under water is carried on by the steam dredging machines at a cheaper rate than the same quantity of materials could be excavated on land, in a common cutting or embankment. It is to these dredging machines that many of the finest harbours in the country are indebted for their efficiency. By the aid, therefore, of steam dredging machinery I would propose to excavate the present canal, or channel, to the required depth, from Chester to Flint. Instead of digging a new canal, I would deepen the old one.

But it has been said, if you deepen the river, "all the slopes of the present banks would require to be reformed and strengthened, in order to prevent them from being undermined." This statement is inconsistent with the fact. From the great breadth of the channel it will admit of the full depth required, by continuing the present slopes of the banks. They will not require to be reformed, and scarcely anywhere require to be strengthened. In so far, therefore, as it will be very much less expensive to deepen the old canal than to make a new one, this plan will unite the advantages of economy and utility.

The next advantage of this plan will be its gradual progress. It is in the upper part of the river, from Chester to the King's Ferry, that the principal loss of depth occurs. By deepening this part of the river, first of all, three feet of additional water might be obtained, so as to admit a larger class of vessels at ordinary spring tides. The value of the harbour would thus be at once increased. Thus, for the first instalment of money expended on the river, an immediate revenue would be obtained, and the harbour permanently benefited, independent of all further outlay.

The next step in improvement would of course be to continue to increase the depth of the channel as money could be obtained, and as the wants of the trade appeared to require it; to build docks at Chester, for the accommodation of the shipping; to erect beacons, and to place buoys, &c., upon the channel in the estuary below, and to increase the present facilities for towing vessels up the river by steam.

As the trade of the port of Chester increased, it might be prudent, in the next place, to endeavour to improve the channel of the river below Flint; and here much less would be requisite than some have imagined. It would only be necessary to assist the natural tendency of the river to excavate for itself a direct channel into the deep water by the Point of Ayr. Any individual who has attended to the progress of the river during the last sixty years must see that it has been occupied incessantly in tracing out a new and more direct channel. The New Cut, or direct channel, originally extended only about six miles. It has every year been extending its channel in that direction, in opposition to the most formidable obstacles. It has at last furrowed a course round the Pentre Rock, upon which it dashed itself in vain for many years. It has pursued its way down to Flint, where it has only been stopped for the present by works of great magnitude and expense. Now it will only be necessary to encourage, instead of opposing the natural force of the current, to remove obstacles out of its way; to direct its current and control it; and in a very short time as direct and beautiful an entrance will be possessed by the River Dee as by any other river in existence.

What has been said about the circumstance of the "tide from the Atlantic keeping open the northern channel, and closing the southern one," is in opposition to well known fact. The truth is just the reverse, as any one will see by looking at the chart of the Mersey, where he will find the deep channel on the southern side, and the sand-banks thrown up on the northern shore—exactly as we should expect that it would be.

In the next place, while it is manifest that the River Dee Company's property would be seriously injured by the said ship canal to Heswell, it is equally plain that their present territory would be extended, and the power of perfect drainage materially increased by lowering the present bed of the river, and effecting the other alterations as now proposed.

What the writer has then to recommend to the citizens of Chester, is not the erection, at ruinous expense, of a work of art, to perpetuate the name of the constructors, at the expense and ruin of those engaged in the mercantile speculation; but to avail themselves prudently and gradually, and as their resources will allow, of the great advantages which the nature of their river, and the exertions of enterprising parties have already placed it in their power easily and peacefully to obtain.

In illustration of the advantage of deepening a river, by the means alluded to, we may adduce the example of many rivers where the power of steam has been applied, and in all with perfect success. Three of these instances have come under our own immediate notice, and, therefore, we can speak of these with the greater certainty—the harbour of Drogheda, on the River Boyne; the harbour of Glasgow, on the River Clyde; the harbour of Perth, on the River Tay.

The harbour of Drogheda is approached from the sea by the River Boyne. For the last three or four years the steam dredge has been incessantly employed on it. The average depth of the water has been increased fully three feet, and the navigation rendered more secure; vessels of the largest class can now sail up to the quay without breaking bulk, and one hour earlier than formerly. In front of the quay wall a space in the channel of 350 feet long has been deepened by the steam dredge to a depth of about nine feet at low water, so as to answer all the purposes of a floating dock for steam vessels, without interfering with the free and open navigation of the river's channel. There were removed by the steam dredge out of the channel in 1834, 94,900 tons of shingle; in 1835, 113,380

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tons; in 1836, 124,240 tons; and all this work was done at the expense of about 5,000*l.* in four years. Now observe what the consequences of the improvements have been. "The town of Drogheda has made more gigantic advances to commercial prosperity within the last three years than any other town in Ireland. Since 1835 it is shown by the authorized returns that the exports in every instance have nearly doubled. The customs duties in 1835 were about 9,000*l.*, and are now about 20,000*l.* The value of the exports was about 1,000,000*l.* in 1837. In consequence of this, several flax-mills are now building, one of which is insured for 29,000*l.*; and also a cotton-mill costing 15,000*l.* Fine powerful and well appointed steamers, and 50 sail of square-rigged vessels are now the exclusive property of the town of Drogheda."

The River Clyde and the harbour of Glasgow furnish another equally striking example of the great and sure benefits resulting from the gradual deepening process of dredging by steam. At the end of the last century the River Clyde was in a much worse state than the River Dee has ever been. "In 1755 and 1756, the celebrated Mr. Smeaton surveyed the Clyde, and proposed to render it navigable by locks, which plan being generally disapproved of, Mr. Golborne, of Chester, civil engineer, made a survey, and reported that the river was in a state of nature, and that as far down as Kilpatrick there were only two feet water, and recommended jetties and groynes instead of locks; these were applied with so much success that, in 1775, vessels drawing six feet could come up the river." Since the invention of dredging by steam, the channel has been so much deepened that vessels drawing 15 and 16 feet of water have come up to Glasgow; and the river is now navigable for steamers at low water. Let us now look at the commercial consequences of these improvements. In 1775 no vessels of more than 30 tons burden could ascend the Clyde to Glasgow even in the high spring tides, and it appears from the returns that, in 1834, 27,000 large vessels ascended the Clyde to Glasgow, with merchandize paying 166,913*l.* of custom-house duties, and about 30,000*l.* of river and harbour dues; and

	£.
From 1755 to 1770, the Clyde River dues were .	174
In 1835	31,910
In 1836	35,000
In 1837	39,000
In 1812 the Custom-house dues were . .	3,124
In 1824	29,926
In 1836	314,701
In 1837	389,702

It also appears from an accurate investigation that if the sum of money required had originally, at the time when these improvements commenced, been expended on a canal, as now proposed for Chester, the present extent of traffic would have been impracticable, and the original cost of the undertaking, with interest, would have long ago overwhelmed the trust with a ruinous debt; whereas, by pursuing a system of gradual expenditure and improvement commensurate to the increasing wants of the growing trade, the revenue of the river has paid for its own improvements, and that after paying in full all past expenditure. The commissioners of the river have now a clear disposable revenue of 30,000*l.* per annum, which they are judiciously laying out in new harbours, docks, lighthouses, beacons, and other improvements, which their rapidly increasing trade requires more rapidly than they can be supplied. Wealth, population, industry, and enterprise have also kept pace with the improvements of the navigation of that river, the improvement of which, be it remarked, as well as of the Boyne, was originated by a Chester engineer, and originally, to a certain extent, in imitation of the improvements of the River Dee. It is to be hoped that the River Dee will not long be allowed to lag behind.

In conclusion, I might be disposed to enlarge upon the improvements recently effected upon the River Tay to Perth, by the excellent measures adopted by Messrs. Robert Stevenson and Sons, whereby, in a space of about three years, the river has been deepened four feet by steam-engine dredging, and whereby the tide now reaches Perth near half an hour earlier then formerly, and the trade of the harbour is in a course of rapid improvement; but I have already done more than enough to show the efficiency and advantages of the method by which I propose that the River Dee should be improved, and to which I give a decided preference over all the other methods, as combining efficiency, prudence, and economy.

In comparison with the method by the new canal, I may also add, as by no means the least advantage of the judicious improvement of the river, that it will unite the interests of all considerable parties, whereas the other would raise up insuperable hostility. The new canal would decidedly injure the property and prospects of the River Dee Company, even supposing it to be efficient for the purposes of navigation. This plan, on the other hand, would ultimately be the means of accelerating the accumulation of property to the River Dee Company. The whole materials excavated from the bed of the river, if deposited upon their property, would be the means of raising a large tract of land rapidly above the level of the sea, so as, by covering it again with the top soil, to produce immediately a valuable tract of arable land. The whole of the company's land along the banks of the river would be increased in commercial value, and the erection of warehouses and the construction of future docks, dockyards, and quays upon their property, would increase it incalculably. All the proprietors along the Welsh coast would find it their interest to have the channel through which they must find egress for their shipping improved and defined, whilst property around Flint, on which the sea is now rapidly encroaching, might be restored and preserved, by proper attention to the channel of the river. By the lowering, also, of the present bed of the river, the drainage of the whole of the country would be very greatly improved, and lands would then be brought into cultivation from which the water cannot now be taken away.

And here I ought to give a decided reply to your excellent friend Civis, who seems to have the interests of Chester sincerely at heart, and is very properly afraid, lest in despair of meeting the enormous expenditure of money upon the Ship Canal, the improvement of the river itself should be abandoned. A few words, however, in answer to his question, will suffice to satisfy him that what be calls "Sir John Rennie's locks and weir at Flint" are impracticable. Nearly the whole drainage of the land of the River Dee Company, and of the proprietors on the southern bank of the river is accomplished by sluices that allow the water to flow out at and about low water, but are covered over and closed at high water. If, therefore, the present channel were converted into a ship canal by closing it with the weir and locks at Flint as aforesaid, the whole of that valuable line would be permanently laid under water. This is an insuperable obstacle, even were there not other practical points in the whole plan to condemn it.

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There remains, then, no practicable plan but the plain, simple, obvious, although much despised one, of energetically commencing the improvement of the open river navigation. The ship canal to Heswell would ruin all connected with it. The plan of closing up the river would damage the surrounding property.

The plan proposed and recommended to the adoption of your Committee, and to the Commissioners and inhabitants of Chester, is then shortly this: by various simple means, and especially by the modern operation of dredging by steam on a large scale, to obtain increased depth, so as to render Chester accessible to vessels drawing 15 feet. To continue this gradual improvement, as the wants and revenue of the traffic require, until 20 feet or more of water are obtained; to render the river navigable by steam at all hours of the tide; to continue and extend the rubble embankments, defining and deepening the channel to and below Flint; to place buoys, beacons, &c., so as to mark out the channel with precision; to obtain the most direct channel from Flint into deep water; and to do all this, not suddenly and at once, so as to incur great expense long before the possibility of a return, and load the undertaking at once with a ruinous debt; but to add all the commercial accommodations in docks, &c., successively as it shall appear that the trade will warrant the expense; and by combining the interests at once of the city of Chester, the River Dee Company, and the proprietors on the banks of the river, and the towns along the Welsh shore, to unite all in an enterprise so manifestly conducive to the common welfare; and that not by immediately sinking a large unremunerating capital, but by the gradual expenditure of sums suited to the gradually improving trade of the river.

I am, &c.,
J. SCOTT RUSSELL.

George Brydges Granville, Esq.,
&c. &c. &c.

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No. 170.
Wedge, on Russell's Letter respecting the Dee.

MR. WEDGE'S *Observations on Mr. Scott Russell's Letter on the Improvement of the River Dee.*

Sealand, Chester, 16th January, 1839.

SIR,

I send Mr. Scott Russell's letter on the improvement of the river Dee, &c., &c.

If Mr. Russell had shown how far the present circumstances of the Dee were similar to those of the rivers at Glasgow, Drogheda, and Perth at the time when the improvements there commenced; how far the length and declination of those rivers, and the materials of which their beds were composed, corresponded with those of the Dee,—he would have furnished information to judge of the eligibility of his proposed plan: but, as it is, the only fact from which any satisfactory conclusion can be drawn (the shingle at Drogheda) makes against his suggestion, and is not at all in favour of it.

I have ascertained more than once that the fall of the surface-line of low water, from Chester Bridge down to below the Queen's Ferry, is only about 7 inches in a mile. Sir John Rennie's assistant found the fall there to be the same as I had found it (7 inches in a mile); and that from low water at Chester Bridge to low water at the point of Aire, a distance of about 24 miles, the fall was only 15 feet 10 inches, a trifle less than 8 inches in a mile. The bed of the Dee, through the whole extent of it, with the exception of a little rock and gravel at Chester New Crane and Rock near to the bridge, is nothing but quicksand, forming nearly a regularly-inclined plane from end to end. Now, if the beds of the rivers, which Mr. Russell refers to, furnished parallel cases to that of the Dee, there might be reasonable grounds for adopting his plan, but he furnishes no data to judge from, with the exception of "shingle" in the Boyne.

On this subject it may be proper to acquaint the Committee, when Mr. Telford was first consulted on the improvement of the Dee navigation, before any money had been laid out upon it, more than 20 years ago, having previously heard that improvement had been made in the Clyde by dredging, I submitted to his consideration the very same plan of improvement as that which Mr. Russell now recommends. Mr. Telford's opinion was, that, in a quicksand constantly liable to be moved and shifted about from place to place by every strong current of tide or fresh water, dredging could answer no durably useful purpose. And thinking, perhaps, that it may be satisfactory to the Committee and myself to know what the sentiments of a gentleman holding an official situation in the Clyde Navigation were upon it, Mr. Telford introduced me by letter to his acquaintance, and I had a correspondence with him upon the subject.

A copy of his letter, which I considered of the most importance, I sent to the Committee on the 4th March, 1820:—

Glasgow, 11th February, 1820.

"In compliance with Mr. Telford's request I beg leave to state, that the general plan adopted for improving our navigation was by ploughing or dredging the shallows to the sides of the river; building jetties to direct the current in a proper channel, and prevent the stuff taken out being washed away, joining the extremities of the jetties by loose whinstone dykes. About 15 years ago, I directed two pairs of harrows (made of wrought-iron), teethed like a mattock, to be used in removing shallows; these shallows, being loosened by drawing the harrows backwards and forwards over them by means of capstons or punts moored up and down the river, the first fresh afterwards swept away a considerable part of the incumbrance. A dredging machine, also, has been of great service to us in deepening and clearing the harbour, and removing one or two shallows formed of sand and gravel on a clay bottom. In the narrow part of the river, however, we have not been able to make much use of the machine, owing to the constant thoroughfare of the steam-vessels at all states of the tide preventing it from being moored for such a length of time as it could be wrought to advantage. In November last, and since our steam-boat navigation has been so much increased, it occurred to me that, by getting these vessels to drag the harrows during a fresh in the river over a shallow which had annoyed us very much, the obstruction might be removed, and I am happy to say, the experiment succeeded. A boat was stationed in the channel to hand a line (made fast to the harrows) to the steam-vessels as they approached the shallow; and when the harrow passed over it, the line was thrown off to the people in the boat, who were ready to hand it again to the first steam-vessel coming in the opposite direction. These attempts were made during land-floods, and when the current was very strong.

"On the whole, our success in deepening the Clyde is mainly to be attributed to contracting and directing the river in the proper channel by parallel dykes.

"JAMES SPREULL."

From the above letter it appears that the shallows were "formed of gravel and sand on a clay bottom," that they were "dredged *to the sides*," which must also have had hard bottoms, for otherwise the "joining of the extremities of the jetties by loose whinstone dykes" could not have been effected. In these circumstances there is no similarity to anything found in the Dee: and it appears, also, that the improvements in the Clyde were owing, "mainly," to the very same plan as was originally adopted by Nathaniel Kinderley, and is now acted upon, viz., contraction of the width of the channel by groins or jetties.

The jetties in the Dee were shortened and lowered in height (as I have before informed you) at two different times, in consequence of complaints made to the Committee of considerable damage having been sustained by large vessels forced upon them by wind or tide; and owing to this it was, that the depth of water in the river became shallower (from the channel being wider) than it had been before. In restoring

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the groynes under Mr. Telford's directions, care was taken that, in their length and distance from each other, they should not endanger the safety of vessels sailing, and occasionally tacking in going up and down the river, more than could well be avoided; and, with the jetties as now formed and placed, the river is in as good a state as it has been remembered to be, I believe, by the oldest person living. But, if they were lengthened as much as I think they might be with safety to vessels towed up and down the river *with steam*, they would afford (as it appears to me) the *best* and most *permanently* effective mode of improvement possible; and I have not the smallest doubt but the depth of water might be materially so increased in the narrow confined part of the river, subject to variations nevertheless, as it always unavoidably will be, from the effect of wet and dry seasons.

In a postscript to Mr. Telford's report, sent to the Committee April 26th, 1829, I added—"Mr. Telford thinks that the implement used in the Clyde, alluded to by Mr. Spreull, would be of no service in the Dee."*

THOMAS WEDGE.

No 171.
Provis's Report on the Dee Company's Works and the Dee.

No. 171.

Report by W. A. PROVIS, Esq., C.E., *on the Dee Company's Works and the River Dee.*

GENTLEMEN,

Ellesmere, 4th *June*, 1839.

In obedience to your instructions, communicated to me on the 22nd ultimo by Mr. Ranken, I lost no time in arranging with your agent, Mr. Wedge, the necessary proceedings, to enable me to report "on the present state of the Company's works and the river."

On the 30th ultimo I commenced my examination of the river, and during that and the two following days I sounded the whole of the channel from Chester to near Flint, and inspected the various works constructed for the restoration and maintenance of the navigation.

Your Acts of Parliament require that a depth of 15 feet water, at the high water of a moderate spring tide, should be maintained: the exact level of such moderate spring tide having been determined and fixed, in relation to a standard then existing near Chester. Unfortunately that standard has long been destroyed, and, as yet, no new one has been established to replace it. Mr. Wedge furnished me with the average of the three highest of each of the spring tides during a period of 21 years, from which, it appears, that the average or medium height of the whole number of spring tides was equal to about 18 feet 3 inches of the Liverpool tide-table.

Mr. Wedge, who liberally gave me any information I required, also put into my hands a series of nearly 50 sets of soundings taken by the supervisors of the river, from 6th August, 1834, to 29th May, 1839, inclusive. During this period the depth of water generally was greater than required by the Acts of Parliament, assuming that a spring tide of medium height may be considered as a moderate spring tide.

There are instances where, for a short time, the depth of water was less than 15 feet; but these, as occasional occurrences, seem to have been anticipated by the Legislature, as no penalty is attached to the Company, unless the deficiency of depth shall exist for four months; and the soundings with which I have been furnished in no case exhibit a want of the required depth for so long a continuance.

The principal works on the north-east side of the river are the earthen embankment and stone facing of the water-way, extending for nearly seven miles below Chester, and the stone mounds or causeways which are continued for a mile and a half further to leeward. On the south western side of the river, its channel is confined and protected by a series of detached stone piers or groins. All these, as well as the sluices for drainage, appear to require but the single observation, that they are in a complete state of repair.

I forbear offering any remarks on the possible improvement of the river,—1st, because they are not required by your present instructions; and, 2ndly, because I think the surveys that are now being made by Messrs. Stevensons will probably lead to suggestions to which an opinion may be more properly directed than to the vague reports that are being circulated.

W. A. PROVIS.

To the Committee of the River Dee Company

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Extract from a letter from Mr. Wedge.

No. 172.

Extract from a Letter from MR. WEDGE, *dated Sealand, 15th June*, 1839.

As it is at the ends of the turns of the river, nearly opposite to lots 15 and 19, where the shallowest parts of it are generally found, owing to eddies which those turns occasion, it will be necessary to increase the number of groins there, and to lengthen them in some instances, as the most effective mode, if not the only certain one, to regulate the depth of the channel (as I have before informed the Committee); it appeared very desirable that those new groins should be begun upon at this favourable season of the year, and I hope the Committee will approve of their having been so. It is only by contracting the width of the low-water channel that the depth can be durably effected in the embanked part of it.

THOMAS WEDGE.

No 173.
Stevenson's Report on Improving the River Dee and Port of Chester.

No. 173.

The Report of ROBERT STEVENSON & SONS, *Civil Engineers, to the Committee of the Inhabitants of Chester, appointed to consider the best means of Improving the Navigation of the River Dee, and the Port and Harbour of Chester.*

Edinburgh, August, 1839.

According to an arrangement made with the committee appointed to consider the best means of improving the navigation of the river Dee, Messrs. Robert and David Stevenson visited Chester in the month of February last, for the purpose of examining the navigation, and reporting how far, in their opinion, it was susceptible of improvement.

The view which the reporters had it then in their power to make, was necessarily of a limited nature; but they were nevertheless enabled to come to the general conclusion, expressed in their report to the committee, dated 12th February, 1839,—"That the navigation of the present channel of the river is susceptible of very material improvement, without in any degree endangering the safety of the noble embankment constructed by the Dee Company, or involving the outlay of a very large amount of capital."

They added, however, that they should find it necessary to make sections and borings of the bed of the river, and otherwise to extend their inquiries on the subject, before being able to state what depth of water could be obtained by the operations which they had in view to recommend, and at what expense these operations could be executed.

The reporters subsequently received instructions to procure the data necessary to enable them to report more fully on the subject, and to form an estimate of the probable expense of effecting an im-

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* The main points of this letter were repeated in one dated 20th April, 1839.

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provement in the navigation. They have accordingly made a trigonometrical and nautical survey of the river from Chester to Flint, from which the plan accompanying this report has been constructed, and with their previous knowledge of the out-flow or entrance of the river Dee, they now submit the following report :—

SURVEY.

The accompanying plan, as will be seen, extends from Chester Bridge to the town of Flint. It shows the high water line and banks of the river, together with the low water channel and sand banks. The small figures marked in black colour, in a fractional form, denote the soundings in the fairway of the river. Those marked above the line, in the place of the numerator, are the depths at high water of ordinary spring tides, and those marked below it, in the place of the denominator, are the depths at low water of ordinary spring tides, when the river is in its state of summer-water. The figures marked in red colour are the depths on the different sand banks at high water. The large figures on the plan, at the margin of the low water channel, indicate the perpendicular rise of the tide at the places where they occur. A longitudinal section of the river, and also several cross sections and borings were made, to enable the reporters to form an estimate of the probable expense of the proposed improvements. The longitudinal section is delineated on the plan, on which a few of the cross sections have also been laid down, in order to show that the operations proposed do not in any way interfere with the embankment constructed by the River Dee Company, so as to endanger the stability or impair the efficiency of that important work.

While the survey was in progress of being made, a register of the rise and fall of the tide was kept at several stations on the river, by means of graduated tide-gauges fixed in reference to a level line, accurately traced from Chester to Flint; and all the high water soundings marked on the plan, and the heights on the sections, have reference to the high water of the same tide. The level which the reporters have adopted as their datum, and to which the soundings and heights alluded to have reference, is that of high water of an ordinary spring tide, which they found to rise 21ft. 6in. at Flint, 14ft. at Connah's Quay, and 12ft. at Chester.

STATE OF THE NAVIGATION.

The part of the navigation to which the attention of the reporters was particularly directed by the committee, and which they have surveyed and shown in the accompanying plan, may be divided into two compartments, both of which are, at present, navigated with much difficulty. One compartment is that portion of the river which extends from Chester to the lower extremity of the mole or causeway, erected by the River Dee Company for the purpose of increasing and protecting their property; and the other extends from the lower end of the stone causeway to the town of Flint.

The greatest deficiency in depth exists in the upper compartment of the navigation, while that below presents obstruction to shipping, chiefly on account of the tortuous and shifting nature of the channels, which, if directed into one course, could not only be navigated with greater safety and facility, but could easily be made to afford a much greater depth of water. The channel of the Dee below Flint, which has been particularly examined by the reporters on this and on former occasions, although tortuous, and like that of all similar estuaries, somewhat liable to change its direction, is nevertheless at high water of sufficient depth for the largest class of merchant vessels; and, when compared with the entrances of other rivers in the neighbourhood, may be termed a good navigation. To this, therefore, the reporters do not now direct the attention of the committee, although they are of opinion, that in the event of executing the works recommended by them for the improvement of the upper part of the river, the committee may afterwards beneficially extend their operations to some parts of the navigation between Flint and the Irish Sea.

NAVIGABLE DEPTH.

At the time the reporters made their survey, the navigable track to Chester, as is shown on the longitudinal section, had in some places little more than 13ft. at high water of ordinary spring tides, and therefore could not be said to afford an available depth to shipping of more than 12ft. at high water. The reporters propose to increase this depth by steam dredging,—a process now so generally and successfully employed in river improvements. Several works must, however, be executed in connection with the dredging, in order to render that operation more decided in its effects and easy in its execution, than it would be if resorted to as the only means of improvement; and to these operations they shall briefly advert.

IMPROVEMENT OF UPPER COMPARTMENT.

The upper part of the river, from the end of the stone causeway to Chester, to the improvement of which the reporters in the first place refer, is, nearly throughout its whole extent, in a bad condition.

In the construction of the artificial canal, which forms this portion of the navigation, it is to be regretted that several sharp and unnatural turns have been introduced. These not only prove great obstructions to the navigation, being inconvenient and even unsafe for shipping, but by distorting the currents, and preventing the free flow of the tide, they tend to produce irregularities in the bed of the river, and to form extensive banks or flats, which greatly reduce the navigable depth.

TURNS BELOW CHEESE HOUSE.

The reporters are of opinion, however, that at the two turns immediately below the cheese house, at which places the want of depth is more frequently complained of, the formation of banks and shallows may in a great measure be prevented, and the general depth of water increased, by the removal of the groins which project into the river, and the substitution of continuous face-walls of rubble stones, similar to that made by the Dee Company along the face of their embankment. A regular curve is a much more advisable and suitable form for a canal, than a turn formed by a series of straight lines, especially in such a situation as that alluded to, where, from the soft nature of the bottom of the river, and the great velocity of the current, it is decidedly injurious to impede or distort the flow of the tide. The operation of forming this part of the navigation into one regular curve would involve too large an outlay to warrant its execution at present; but the reporters beg to bring this work under the notice of the committee, as one which they may ultimately find it advisable to undertake. They recommend, however, that in the mean time, the face-walls to which they have alluded should be erected, and that they should be formed in the lines marked on the accompanying plan, which are laid down in such a

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manner that the extensive reaches above and below the turns may, as nearly as possible, be tangents to the curves at the upper and lower extremities of the short intermediate straight part of the navigation.

CHEESE HOUSE.

The curve at the cheese house, near Chester, is also very objectionable, and might be improved at some future period; but in the mean time the great contraction which takes place at this point ought to be removed, and the width of the channel increased to the extent shown in the plan, by cutting away a part of the bank, and dredging the bed of the river.

CONNAH'S QUAY.

At Connah's Quay the river has been forced into an unnatural course by the erection of jetties and other means. Great improvements can be effected at this place without removing the navigable channel from the quay, by altering the course of the River Dee Company's causeway in the manner shown by a red dotted line on the plan; but the reporters allude to this as an improvement which may be effected at some future period, and not as an operation which they recommend the committee to undertake at present.

IMPROVEMENT OF LOWER COMPARTMENT.

The lower compartment of the river, or that between the causeway and Flint, presents obstructions to shipping (as formerly noticed), chiefly on account of the tortuous and shifting nature of the navigable channels which wind through the sand banks. The reporters attribute the tendency which the river has, at this part of its course, to flow towards the Cheshire shore, in a great measure to the effect of the Pentre rock and the hard rocky point of Flint Castle on the flood tide, which sets in strongly upon these obstructions to its direct course, and is thrown off towards the opposite side of the river. The reporters recommend, as the best means of obviating this, and improving the lower part of the navigation, that the causeway already constructed by the Dee Company, under the direction of the late Mr Telford, should be continued till it reaches a point opposite the Pentre rock, in the direction shown in red ink on the plan. A part of the Pentre rock should also be removed, so as to admit the free flow of the tide, to which it at present presents a great obstruction, and the materials excavated in executing this operation should be applied to extending the mole or causeway, in the manner described.

The reporters do not consider it necessary to form a wall of the same magnitude as that already erected by the Dee Company, the object of which was somewhat different. A low bulwark, with occasional beacons for the guidance of shipping, will, in their opinion, be quite sufficient for all the purposes connected with the navigation.

DREDGING.

These works will, if executed, act most beneficially in rendering the navigation less difficult, and will also, in a limited degree, deepen the shallowest parts of the channel; but their most important effect may be said to be that of preparing the river for the process of deepening, and of rendering the navigation susceptible of improvement by steam dredging to a great extent. The reporters, therefore, recommend to the Committee, as one of the first steps towards the improvement of the navigation, that a dredging machine, with the necessary apparatus, be provided.

A line has been drawn on the section, showing the extent of dredging necessary to obtain a navigable depth to Chester of 16ft. at high water of ordinary spring tides. This important improvement may be effected in from 12 to 14 months, after which the depth might, if necessary, be gradually increased to suit the growing trade, to the extent of 18ft. or 20ft.

ESTIMATE.

The reporters have annexed an estimate of the probable expense of executing the several works enumerated, which including the extension of the causeway to the Pentre rock, and the other works in the upper part of the navigation, the purchase of a dredging engine with apparatus, and the cost of dredging necessary to obtain 16ft. of water, together with 10 per cent. for incidents, amounts to the sum of 24,905*l.* 10*s.* 9*d.*

EXTENDED OPERATIONS.

They have also estimated, in a more general way, the expense of increasing the depth of the river to 20ft., which they are of opinion may be accomplished with two steam dredges in the course of from three to four years, for an additional sum of about 20,000*l.*

CONCLUSION.

So much as already been written on the subject of improving the Dee, that the reporters judge it unnecessary at present to do more than briefly to enumerate those operations, which they consider best adapted for effecting that very important object. They, however, beg to assure the committee, that the several views of the subject which have been submitted to them, as well as the many suggestions that were made while the survey was in progress, have received their attentive consideration, and that the course recommended by them for the adoption of the committee is that which the reporters consider, under all circumstances, best calculated to promote the trade of the port of Chester.

The trade of this port, from its situation in a highly cultivated and populous country, and from the numerous railway communications that are now being formed in its neighbourhood, must, if encouraged, rapidly increase; while the city itself, at as little cost and to as great an extent as any place with which the reporters are acquainted, is susceptible, by means of quays and wet docks, of a vast increase of shipping accommodation. It therefore becomes an object of great interest to the inhabitants, that their communication, with the ocean—that most important of all communications to a maritime town—should be rendered safe and easy for the shipping which frequents their port.

ROBERT STEVENSON and SONS.

Edinburgh, 21*st August*, 1839.

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Estimate of the probable expense of improving the Navigation of the River Dee, from Chester to Flint, and of obtaining 16ft. at high water of ordinary spring tides up to Chester, by ROBERT STEVENSON *and* SONS, *Civil Engineers.*

	£.	s.	d.
For improving the turn at the cheese house	350	0	0
For forming rubble face-walls at the first and second turns below the cheese house	1,527	15	0
For extending the stone causeway from the lower Barrel Perch to the Pentre Rock, including perches or beacons	11,304	15	0
For a steam dredge, with apparatus and punts, and for dredging the bed of the river, so as to obtain 16ft. at high water of ordinary spring tides	9,458	18	0
Incidents on 22,261*l.* 8*s.* at 10 per cent.	2.264	2	9
	£24,905	10	9

No. 174.

No 174.
Report of the Committee for improving the Port of Chester.

Report of the Committee appointed at a Public Meeting held at the Exchange, in the City of Chester, on Monday, the 24th day of December, 1838. *for the purpose of taking into consideration the best means of improving the Port and Harbour of Chester.*

Chester, 10th September, 1839.

Your committee having examined the various plans which have been proposed for attaining the object of the general meeting, came to the conclusion that the best and most practicable mode of benefitting the city of Chester, with reference to the port and harbour, trade, and commerce, would be to improve the open river navigation of the Dee.

Although from the information which they had previously been put in possession of, and particularly through the letter of Mr. John Scott Russell they were of opinion that such improvement of the river might be effected in a great measure by steam dredging, yet they deemed it unadvisable to come to any future general meeting that might be called, without the support and sanction of a regular report from civil engineers.

They accordingly, in the first place, set on foot a subscription in the city and neighbourhood of Chester to meet the necessary expenses connected with such report and other matters.

They also applied to the River Dee Company for their co-operation in obtaining a survey of the Dee, and availed themselves of the offer of Mr. Stevenson and Mr. Russell to explain their views in person to the committee in London.

They regret to say that thus far the Company have declined the proposals made to them, although your committee have reason to hope that the statements of Messrs. Stevenson and Russell made some impression upon the London Committee.

Your committee finally determined to engage the celebrated civil engineers, Messrs. Robert Stevenson and Sons, of Edinburgh, to make a regular survey of the river, and to give their opinion as to the best mode of proceeding for the attainment of the desired improvements.

Messrs. Stevenson accordingly made a preliminary survey, and delivered in a report, dated 12th February; and having since under the authority of your committee completed an extensive trigonometrical and nautical survey, submit their final report, dated 21st August, 1839, accompanied by a plan, sections, and borings of the river.

These your committee now beg leave to recommend to the special attention of the meeting, with the hope that they will be found to confirm the opinion previously entertained as to the practicability of improving the navigation of the river; and your committee believe that the improvement may be made without such an expenditure, as would render it necessary to lay a heavy toll upon vessels coming into the river.

Under all these circumstances your committee entertain a confident expectation, that this meeting will adopt the necessary measures for causing the recommendations contained in the report of Messrs. Stevenson to be carried into effect, and with as little delay as possible.

G. B. GRANVILLE, *Chairman.*

No. 175.

No. 175.
Provis's Second Report on the Dee.

Second Report by W. A. PROVIS, Esq., C.E., *on the River Dee.*

29th November, 1839.

GENTLEMEN,

Through the medium of a letter dated the 23rd October, from Mr. Ranken, I was favoured with your instructions to investigate and give my opinion on the "Reports of the Committee appointed to consider the best means of promoting the improvement of the Port and Harbour of Chester; and of Robert Stevenson and Sons, Civil Engineers, relative to the Improvement of the Navigation on the River Dee."

In pursuance of these instructions, I have attentively perused the reports referred to, and also again examined the river Dee from Chester to Flint.

In the first-mentioned report the Committee state their opinion, "That the best and most practicable mode of benefiting the city of Chester, with reference to her port and harbour, trade and commerce, would be to improve the open river navigation of the Dee, and that such improvement of the river might be effected, in a great measure, by steam dredging." The Committee, however, deemed it advisable to have the sanction of civil engineers, and therefore employed Messrs. Robert Stevenson and Sons, of Edinburgh, to give their opinion as to the best mode of proceeding for the attainment of the desired improvement.

The report of the Messrs. Stevensons, accompanied by a plan, section, and borings of the river, was submitted to the said Committee in August last; and it is to this report, plan, and sections, that I shall now more especially direct my observations.

The plan and sections appear to have been made with great care; and as I was favoured by the town clerk of Chester (J. T. Maddock, Esq.) with permission to make extracts from these documents, I have thought it proper to send herewith a tracing from the plan—a reference to which will, I hope, make the whole subject intelligible and distinct.

Proposed Improvements.

From the report it appears that, in a preliminary one of the 12th February last, the Messrs. Stevenson had stated, "That the navigation of the present channel of the river is susceptible of very material improvement, without in any degree endangering the safety of the noble embankment constructed by the Dee Company, or involving the outlay of a very large amount of capital." That the channel may be improved, I readily admit, but great improvement can only be effected by commensurate expenditure.

In discussing the "state of the navigation," Messrs. Stevensons divide it into two compartments. The one is that portion of the river which extends from Chester to the lower extremity of the mole or causeway, erected by the River Dee Company, for the purpose of increasing and protecting their property; and the other extends from the lower end of the stone causeway to the town of Flint. I must here observe, that the motives which have been assigned for the construction by the Dee Company of the mole or causeway are not correct. It was constructed solely with a view to the improvement of the navigation of the river: and that part of it known as the New Causeway, was done by the advice and under the direction of the late Mr. Telford. In a subsequent part of their report, the Messrs. Stevenson recommend the extension of this same causeway for two miles towards Flint.

It is truly stated, "That the greatest deficiency of depth exists in the upper compartment," which Messrs. Stevensons observe, "had in some places little more than 13 feet at high water of ordinary spring tides." To increase this depth, those gentlemen have proposed steam dredging in connexion with other works, which, we are afterwards informed, include widening the river at the Cheese House, near Chester; the removal of the groins at the bends below the Cheese House, and substituting face walls of rubble stones; and the alteration (though not immediately) of the old causeway opposite Connah's Quay. These are shown by red lines on the accompanying tracing.

With regard to the quick curve at the Cheese House, I consider it would be improved by cutting off the point of land as proposed, provided the river were contracted, and its shore protected on the opposite side. Unless this were done, I am of opinion, that owing to the direction of the currents of ebb and flow, there would always be comparative slack water over the lowest point; that a deposition of sand and mud would take place upon it, and that it would become an inconvenient shoal. There is no protection of this kind alluded to in Messrs. Stevensons' report, or included in their estimate.

At the bends below the Cheese House, I fully concur in the propriety of continuous face walls of rubble stones, instead of the existing groins; and this opinion I stated to your agent, Mr. Wedge, at the time I examined the river in May last. If I differ at all from Messrs. Stevensons, it is in the wish to see those walls more extended in length than they have proposed; but I have no doubt it was an economical consideration, which induced them to confine this improvement within the limits of the red lines upon their plan.

Along the straight parts of the river, where not near to and influenced by these bends, the mode which has been adopted on the south-west shore, of confining the water by a series of jetties or groins, has brought the depth in the fair way of the river to a considerable degree of uniformity. The direction of the great mass of moving water is not so much obstructed by the ends of the groins as to cause considerable eddies and consequent shoals in the mid-channel. It is true, that at the points of the groins holes have been gullied, and accumulations of sand have taken place between them; but, being out of the usual track of vessels, they are not of serious consequence, though they are evidence of power unprofitably exerted. Wherever there is a want of the general depth in the centre of the river, it may, in most instances, be traced to the removal of a groin, the inequality of distances between them, or to causes not beyond the reach of economical remedy. At the bends it is evident, on inspection of the map, that the directions of the flood tides, and of the ebb thereof, with the inland waters, are such as to cause their currents to set hard upon the south-west or Flintshire shore: the natural tendency to run along that shore is, however, checked by the groins, so that between the first tendency, and the subsequent check, the current is driven to the opposite side of the river, from which it is again thrown off; and thus, with diminishing energy, these deflections are repeated till they are lost to observation, and cease to be of importance.

But the first efforts of the resisted current are violent; so much so, that on observing the depths figured on the tracing sent herewith, it will be seen, that while there is in the long straight reach of the river below the bends generally from 2½ to 7 feet of water when the tide is out, there are at the bends holes of 13 feet in depth, and shoals of only as many inches. It is with the view of more nearly equalizing these depths, that I recommend the continuous stone face walls round the south-west shore of the bends. The currents would then strike the stone facing, so as to be deflected in the least degree, the whole water would exert the most uniform and beneficial scour, and preserve the greatest regularity of depth that the general shape of the river and natural causes will permit.

The dredging, to obtain up to Chester a depth of 16 feet water at ordinary spring tides, is proposed by Messrs. Stevensons to be effected on the two compartments of the river; but I believe that in the upper compartment it will be useless. If the proposed new channel, from the lower causeway to opposite Pentre Rook, be excavated and protected, an additional proportionate fall will be obtained for the whole of the river above; and this, by giving increased scouring power to the fresh water, will deepen the river (the bed of which is wholly of sand), in all probability, to the full extent which can be afterwards maintained by the natural power of the water. To dredge below this depth would, I think, be expense thrown away; and I am strengthened in this opinion by the results of observation.

I consider the projected improvements near the Cheese House and at the bends to be of local character, and that they do not materially affect the long straight reaches of the river. Were the latter of constant uniform depth, it would be fair to argue, that, as the power of the water was sufficient at all times to maintain that depth, it was possible that a greater might be preserved, if, by other aid, it could be first obtained. Such cases may exist, as where shoals or a generally hard bottom will not yield to the action of the waters passing over them, though that action would be competent to prevent the deposition of sand or mud, if the bed were lowered. But from the soundings of the river Dee, which have been before me, it is clear that it is a river of inconstant depth, dependent on various circumstances of winds, tides, and sand floods. At times it has had a depth greater than the proposed 16 feet, and at others less. To me, it appears immaterial whether the greater depth were obtained by the aid of land-floods, wheelbarrows, or steam-dredges; it is a fact that the depth has been obtained, and equally true that, on a change of natural causes, the depth could not be maintained. To whatever depth the river may be excavated, it is only the natural power of the water, properly directed, that can be permanently applied to its maintenance, without involving continual and incalculable expense. If after the improvement of the channel by increasing its fall, the depth of 16 feet could not be (as I believe would be the case) at all times preserved, I should advise contracting the width of the upper part of the river, by a continuous wall of stones, connecting the points of the groins, similar to that recommended at the bends. This, by keeping the stream within proper bounds, would direct its energies so as to produce the most efficient scour, and consequently the greatest and most uniform depth of water.

Opposite Connah's Quay is the old causeway, constructed probably in the most advisable direction, which then existing circumstances pointed out, though the evidence of those circumstances no longer exist. The groins have apparently been projected from it to force the current of the river towards Connah's Quay, so as to make it more available as a shipping place. Messrs. Stevensons have proposed to confine and regulate the channel in its present general direction, and protect it by stones from the old causeway; but to postpone doing this till some future period. The cost of this improvement is therefore not included in the estimates attached to their report.

The great improvement which Messrs. Stevensons have recommended in the lower compartment of the river is, "That the causeway already constructed by the Dee Company, under the direction of the late Mr.

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Telford, should be continued till it reaches a point opposite Pentre Rock, in the direction shown in red ink on the plan." The stone for constructing this mound or causeway to be in part taken from the Pentre Rock, so as to allow the tide to flow over it more freely. Within this mound a new navigable channel is to be dredged.

There does not exist a doubt that this continuation of Mr. Telford's causeway, and the formation of the new channel, would essentially improve the river; but I fear the expense would be much greater than has been estimated. It is true it is proposed to make only "a low bulwark, with occasional beacons for the guidance of shipping;" but I am of opinion that a mound of much less magnitude than the new causeway would not show its head above the sands, nor effect the object intended. An engineer may determine the height to which he would carry up such a mound, but he cannot limit the depth through which the stones shall sink. The whole extent of the proposed bulwark would be on sand, easily moved by the force of currents; and these, during the crossing of the old channels and the excavation of the new one, would be brought to bear strongly on the fickle foundation of the bulwark, and would carry away the sand to a very great extent. I am informed that, in constructing the last new causeway, the sand was washed away to depths varying from 15 to 25 feet below low water; and I cannot see a reason why the new bulwark should be exempted from similar casualties, or even from still greater, owing to its increased exposure.

Estimate.

To this part of the subject I have given my best attention, and am sorry to find that my ideas of probable cost differ so widely from those of Messrs. Stevenson's. My own general experience, as well as the local knowledge of others, have been applied to arrive as nearly at the truth as the nature of this sort of works will permit. The results I have arrived at are as follow:—

	£.	s.	d.
To cut away the point of earth and rock opposite the Cheese House, and to regulate the shape of, and protect the shore on the other side of the river; to construct rubble stone face walls at the first and second turns (or Bends, as they are locally named,) below the Cheese House; to extend the stone causeway from the Lower Barrel Perch to the Pentre Rock, including perches or beacons, steam dredges, with lighters, &c., and dredging the lower compartment of the river to the depth proposed, but exclusive of any dredging in the upper compartment	59,486	0	0
Contingencies at 10 per cent.	5,948	0	0
Together	£65,434	0	0

I have to observe, that the foregoing estimate does not include the expense of improving and protecting the channel opposite the Old Causeway, as Messrs. Stevensons do not propose to carry that part of their plan into immediate execution, and have, therefore, excluded it from their estimates. I have confined myself to the works proposed by those gentlemen, with the exception of adding a protection to the north bank of the river at the Cheese House, and omitting the dredging of the upper compartment of the river, which I consider would be useless.

Proposed "River Dee Navigation Company."

It appears from advertisements in the newspapers that the projected River Dee Navigation Company purpose applying to Parliament for powers to enable them, not only to carry into effect the works suggested by Messrs. Stevensons, but to take out of the hands of the existing Dee Company those which they have constructed. Of course, the latter party will watch the progress of any Bill which may be brought before the Legislature for such a purpose, and take care that their own just rights shall be protected. The public, also, will do well to examine what security they are to possess for the proper maintenance of the river, if it is allowed to pass into other hands. The calumnies which have been circulated against the Dee Company have not, I believe, sprung from any dissatisfaction on the part of the public as to the Dee Company's proceedings; for, if the latter be well and honestly considered, it will be found that the Company have deserved a better reward than has hitherto fallen to their lot. The Company have now, for upwards of a century, been expending their capital, under advice of the most able engineers, in the restoration and preservation of the river. For 50 years of this period they received no return whatever for their expenditure; and if all the dividend they have ever received be compared with the money laid out, and interest upon the same, whilst it was unproductive, it will be seen that a few shillings per cent. per annum has been their whole remuneration.

Present state of the River.

In my report of June last, I stated that, from an examination of the supervisor's soundings, and comparing them with the assumed standard high water during the previous period of nearly five years, there had generally been the full depth required by the Act of Parliament, and that, when a deficiency of depth had occurred, it had not, in a single case, continued so long as four months. An instance to the contrary has, however, since occurred, owing, without doubt, to the extreme dry weather of the spring and early summer depriving the river of the scouring power of the fresh water. The depth was restored by the autumnal floods, and when I visited the river in the early part of this month, the depth exceeded 15 feet.

With a view to prevent the recurrance of such diminished depth of water, your agent, within the period of my two visits, had caused three new groins to be constructed, and some others lengthened. Though done with the best intention, I regret it, because I am satisfied that no system of groins can make the bends equally perfect with the straight reaches of the river above and below their influence. I feel, therefore, that it is my duty to advise, instead of additional groins, the construction of continuous stone-facings round the south shore of the bend. There is no necessity for doing the whole at once; each bend may be taken separately, and the effect of one will then be shown before incurring expense with the other.

In point of repair I am glad to observe, that the whole of your river works are maintained in excellent order.

I am not aware that there is any other matter to which I need at present allude; but the Committee will oblige me by requesting information if there is any part of their instructions which I have omitted to notice, or on which they may wish for further explanation.

W. A. Provis.

To the Committee of the River Dee Company.

No. 176.

Mr. Wedge's *Report on* Messrs. Stevenson's *Plan for Improving the River Dee.*

No. 176.

Wedge, on Stevenson's plan for Improving the Dee.

Sir, 4th *January*, 1840.

I should not have presumed to give an opinion on any part of Mr. Stevenson's report had not the Committee desired me to do so, as being connected with the recommendation of Mr. Provis to adopt their plan of facing the bends of the river, on the Flintshire side, with rubble stone; but having long been

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Wedge, on Stevenson's plan for Improving the Dee.

acquainted with Mr. Telford's sentiments on the subject of the river, and had many years' observation of the effect of the plans recommended by him, I have less hesitation in stating my own opinion than I otherwise should.

It must be quite evident that in an embanked channel of a river like that of the Dee, composed entirely of moveable sand, and subject to almost daily changes of depth, the force and scouring effect of the currents of tide and fresh water will be greater or less according to the width or narrowness of the low-water channel; and one of the first material points of improvement to consider, as it appears to me (and a very difficult one to decide upon), is what is the utmost limit to which contraction may be carried consistently with the greatest scouring effect of the currents, with the safety of vessels navigating in the river, and a due regard to space for the ebbing and flowing water. I quite agree with Messrs. Stevenson and Provis that a rubble-stone wall, facing along the Flintshire side of the river from end to end of the embanked part of it, would be the best possible mode of improvement, but at an expense of time and money beyond the compass of calculation, provided "the utmost limit of contraction" could be ascertained. At the lower end where the tide comes in with the greatest force, and where there is the greatest accumulation of land water, the low-water channel should be widest; and at the upper end, for contrary reasons, narrowest; the plan to narrow the channel, whatever it may be, should be executed so as, in effect, to act correspondingly, one place to another, or as nearly so as practicable. With groins which may be lengthened, shortened, or removed, or with new ones, changes may be made, accordingly as circumstances required them. But a stone-wall facing must remain unalterably fixed wherever it is put down, whether rightly placed or not. The stone facing, as shown on Messrs. Stevensons' plan, would contract the width of that part of the channel where the shallowest part of it is never found, and would consequently tend to deepen it, where comparatively no increased depth is wanted; and it would therefore be difficult, if not impossible, to determine where to begin, or where end, so as to produce an uniformity of scouring effect above and below the bends of the river.

When the shallowest part of the river is generally in or near to the same place, the lengthening of a groin or the making a new one will remove it; but when the shallowest part is moveable, or not frequently in the same place, it affords proof that the groins are correspondingly effective, one place to another, and all that would then seem necessary to do would be to lengthen the whole of them, if circumstances required it. An instance of the effect produced where a groin is wanted is clearly shown at a shipping wharf, where the low-water channel is much wider than it is either above or below, near to the lower ferry, where vessels take in and discharge their lading exactly at the place where a groin would otherwise have been made, and opposite to that place there is always a less depth of water than either above or below it.

Messrs. Stevensons are not correct as to the want of depth in the places where their "continuous face walls of rubble-stone" are proposed to be made (see page 9 of their report). In the bends of the river the water is never shallowest, but has been so in the straight parts of the river, either above or below the bends of the river; and previously to July last the shallowest parts were almost regularly in one of five different places (opposite lots 15 and 16), at a short distance from the commencement of the first bend of the river. The three new groins, mentioned by Mr Provis, have removed the shallows completely from all those five different places, but whether they will continue to act as effectively in future as they hitherto have done remains to be seen; I see no reason to doubt it.

I quite agree with Mr. Provis in what he says of the navigation below Connah's Quay. If the new causeway was carried forward towards Flint, it would, by straightening and shortening the course of the channel, not only improve the navigation in that part more effectually than would be attained in any other way, but effect the only sure basis for any material improvements in the narrow part of the river above the quay.

Considering, however, that at the end of the new causeway there are not fewer than 200 tons of stone in every yard lengthways, the expense and length of time which would be required to carry on a work of such magnitude two miles, to Pentre Rock, would necessarily be very great.

It is impossible to estimate the expense which would be required to carry into execution the whole of Messrs. Stevensons' plans with any degree of exactness, but I have not the smallest doubt but that Mr. Provis has under-rated the amount of it rather than otherwise.

In Mr. Provis's letter to Mr. Ranken, he appears to think it probable that the execution of the works, recommended to be made by Messrs. Stevensons at the bends of the river, would tend to conciliate the parties at Chester who are engaged in the river improvement scheme; this is entirely a matter of opinion, and, of course, of great uncertainty; my own, however, is decidedly otherwise, and that the concession of one point would encourage a call for others, without knowing where those calls would end. And, after all, the chief point at issue is, what is "a moderate spring tide;" and until that point is settled, questions of improvement as to the expediency or otherwise of the different plans proposed will never be set at rest.

I am, &c.,
THOMAS WEDGE.

No. 177.
Extract from a Letter from Mr. Wedge.

No. 177.

Extract from a Letter from MR. WEDGE.

Sealand, 28*th March*, 1840.

IN reference to your inquiry relative to the groins, it may be proper to state the number of tons raised and carried out since the 5th July last, and to what purposes applied:—

	Tons.
Repairing groins generally, common repairs	2594½
1st new groin	507½
2nd "	667
3rd "	570
4th " opposite poplar tree, in part	127
Old causeway	16
New "	461
Lot 39, Pabers	16
Lot 40, a plat	2
Lengthening and repairing 3rd groin north of Connah's Quay, on this side the river	109
" " 3 groins south of Connah's Quay, on the other side of the river	1418
North Bank repairs	136
	6624

I am not aware, at present, that any more new groins will be wanted, but as there is a constant wear, more or less, of the ends and sides of all of them, there is now rather more of that kind of work required than usual, particularly to the groins between the end of the Horse-shoe Bank and Connah's Quay, and to a few in the upper part of the river; and when these are completed, as well as the 4th new groin, which I expect they will all be at an extra expense of about 140*l.*, there will afterwards be only the common repairs of the river to attend to (as far as can be foreseen at present) at an expense of about 8*l.* or 9*l.* a week.

The low-water channel, which some time ago turned towards the Cheshire shore from the lower end of the new stone causeway, and ran circuitously for a considerable distance that way, now runs in a much more favourable straightforward direction towards Pentre Rock, into which it has been forced by the late land floods.

THOMAS WEDGE.

APPENDIX B.

CHESTER.
River Dee.

No. 178.

No. 178.

Provis, on Wedge's Report on Stevenson's Plan for Improving the Dee.

Mr. PROVIS, *on* Mr. WEDGE's *Report on* Messrs. STEVENSON's *Plan for Improving the River Dee.*

GENTLEMEN, *18th April*, 1840.

In the early part of the present month I was favoured by Mr. Rankon with the following resolution of the River Dee Committee:—

> "That a copy of Mr. Wedge's letter of the 4th January last, containing his observations on Mr. Provis's report, and especially in reference to the walls or groins in the bends of the river, be sent to Mr. Ranken, to be forwarded to Mr. Provis, with a request that he will take those observations into consideration, and communicate to the Committee how far they do or do not tend to modify the views he had formed with respect to the greater eligibility of walls."

At the same time was forwarded to me a copy of Mr. Wedge's letter, alluded to in the above resolution.

Having had occasion to be in Chester very recently, I walked down the river bank past the bends, and have since obtained a continuation of the series of soundings of the river to as late a date as the 17th instant. With the additional information thus procured, and having given the whole subject my most anxious reconsideration, I proceed to my remarks on Mr. Wedge's letter.

I am fully aware of the value which was attached by the late Mr. Telford to the great experience and sound views possessed by Mr. Wedge, especially in matters connected with the improvement of the River Dee. I trust, too, that I may be allowed to express how much I have felt myself indebted to Mr. Wedge for his free communication of facts, and the candid statement of his opinions in the many interviews with which I have been favoured.

With regard to the walls or groins at the bends, to which the Committee have particularly directed my attention, I think there is nothing irreconcileable in the opinions entertained by the late Mr. Telford, Mr. Wedge, and myself. Mr. Wedge states, "That a rubble stone-wall facing along the Flintshire side of the river, from end to end of the embanked part of it, would be the *best possible* mode of improvement (but at an expense of time and money beyond the compass of calculation), provided the utmost limit of contraction could be ascertained."

I admit the difficulty, nay even impossibility, of fixing such a breadth for the river as shall be at all times, and under all circumstances, the best; for the causes which affect the state of the river are ever varying, and the width ought (if it were practicable) to vary so as to suit every change. But as a width cannot be fixed that will be always perfection, that which is nearest to it must be adopted; and I think that the long continued observation of such a man as Mr. Wedge, who seems to have watched every fact connected with the river, would enable him to define a breadth that would be a very close approximation to the true one.

In a newly-embanked channel, such as was that of the Dee, where no sufficient guiding facts existed, I think that contraction and regulation by means of groins was the best way of proceeding, because they admitted of extension from time to time, as long as such extension appeared beneficial: they were also an economical mode of bringing the river into a considerable degree of perfection. But this having been done, I think no one will dispute that (had cost been out of the consideration) a more uniform and effective direction would have been given to the waters had they been permitted to move smoothly onward, bounded by a parallel wall connecting the points of the groins, than by having their course checked and distorted, as it necessarily must be, by the end of every groin with which they come in contact.

But it is right that cost should be considered, and, therefore, I am far from recommending to the Committee such an outlay as this wall would involve, if carried into effect, throughout the whole extent of the embanked river. I cannot, however, avoid seeing that the bends, and those portions of the straight reaches under their immediate influence, are in a worse state than the other parts of the river; and my object in advising a better mode than groins of directing the currents at the bends is, to make those places, as far as practicable, equally good with the rest of the river.

Had the late Mr. Telford been alive, I believe he would have entertained similar views; for, having witnessed the success of the general plan of contracting and directing the river by means of groins, he would not have been satisfied without endeavouring to remedy any partial defect by other and more suitable methods.

Mr. Wedge admits that a continuous wall would be better than groins, if the cost were not too great, and the line for the wall could be correctly fixed. To these it may be answered, that, by way of trial, only one bend need be attempted till the result be proved, and this would not require a very serious expenditure. As to the direction of the wall, no one is perhaps better able to advise upon, or decide it, than Mr. Wedge himself, if he has not already fixed it in his own opinion at or near to the terminal points of the groins.

The red lines on Messrs. Stevensons' map appear to me to have been laid down, not so much with the view of creating additional scour at the bends, as to cause one that should be more uniform in its effects, and to direct the main body of the water more fairly upon the shoals above and below.

The three new groins above the upper bend (being intermediate between four consecutive old ones) have aided the flood in removing, for the present, the adjacent shoal; nor can I doubt that improvement would be effected, if an additional groin were constructed between every two of those that now exist, for every such introduction of an intermediate groin would lessen the spaces between them: and were this operation again and again repeated, the groins would at last touch each other, and their points become the continuous wall which has so often been adverted to. In my last report, I expressed my regret that the last three new groins had been constructed; not that I considered them useless, but because I considered it would have been more advisable to have laid out the money they had cost in commencing a continuous wall.

On the whole I am confirmed in the opinion expressed in my last report, that, in order to make the bends equally good with the rest of the river, they should be faced on the Flintshire side with rubble stone-walls, parallel with the course of the stream.

To the Committee of the River Dee Company. W. A. PROVIS.

No. 179.

No. 179.

Extract from Letter from Mr. Wedge.

Extract from Letter from Mr. WEDGE.

SIR, *Sealand, 16th June*, 1840.

I omitted to mention in my letter of yesterday, that one of the two groins proposed to be made between the end of the Horse-shoe Bank and Connah's Quay is finished, and has so far produced the effect intended from it; and when the other is finished, which it will be in about a month, the contiguous shoal will be, I expect, principally if not wholly removed. In addition to the above, only one more new groin, that I am at present aware of, will be wanted, and that between the two bends of the river. There will always be a shallowest part somewhere; and when (as I have before observed) it is not regularly at or near to the same point, but shifts about according to circumstances from place to place, it shows that the contraction of the channel acts, correspondingly, one place to another.

THOMAS WEDGE.

CHESTER.
River Dee.

No. 180.

Hamilton, on the meeting of the Tidal Harbour Commission at Chester.

No. 180.

Letter from W. J. HAMILTON, Esq., F.R.S., Chairman of the River Dee Committee, *with reference to the Meeting of the Tidal Harbours Commission at Chester, on the 16th October*, 1845.

River Dee Office, 9, Mansion House Street,
London, 26th November, 1845.

SIR,

I have been requested, as Chairman of the River Dee Committee, to address you with reference to a report which has appeared in the Chester newspapers of what passed at a meeting held in that city on the 16th of last month, by yourself and Mr. Godson, as Commissioners for inquiring into the state of the Tidal Rivers and Navigation of the United Kingdom, and, on that particular occasion, the River Dee and Port of Chester. According to the observations reported to have been made by yourself and Mr. Godson at this meeting, you appear to have been impressed with the opinion, that the unfavourable state of the river at the time you inspected it was in a great degree attributable to the neglect of the River Dee Company in fulfilling the obligations, imposed upon them under their different Acts of Parliament, for the improvement of the river Dee and port of Chester; likewise, that the Company had not only neglected to fulfil these obligations, but had either themselves removed, or permitted others to remove the standard directed to be kept up for the express purpose of ascertaining the depth of water that they were bound to maintain in the river. That the Company had, further, paid more attention to reclaiming and embanking portions of the estuary and waste land for their own benefit, than in improving and maintaining the river and navigation for the benefit of the citizens of Chester. That they had made a bargain for their own advantage, to the prejudice of the citizens, the former conservators of the navigation, and proprietors of the waste land, called the White Sands, vested by Parliament in the River Dee Company, on their undertaking the improvement of the river Dee and port of Chester. Upon these four charges against the River Dee Company the Committee have requested me to communicate to you and your colleague, Mr. Godson, the following statement of facts, which they are ready to substantiate, if necessary, by evidence.

With regard to the state of the river at the time you inspected it, and to the supposed neglect of the River Dee Company of the obligations imposed by their Acts of Parliament, I have to observe,—1st. That, during the last two years, an uninterrupted succession of drought, and absence of freshes, have existed in the river Dee, unexampled in the memory of the oldest inhabitant of the neighbourhood, which might sufficiently account for the state of the river at that time, without any imputation upon the River Dee Company. 2nd. The Acts of Parliament above alluded to expressly contemplated occasional deficiency of the statutory depth, and interruption of the navigation from natural causes. 3rd. Instead of neglecting the obligations imposed upon them, the River Dee Company, from the time of their first making the present channel for the river, nearly a century and a half ago (which they then did under the direction of the most experienced engineers, and at a very large expenditure of capital), up to the present period, have continued on every occasion to act under the best professional advice in improving and maintaining it, and a succession of reports from the late Mr. Telford (who was their engineer for many years, and till the time of his death, and subsequently by Mr. Provis), will prove their expenditure, their exertions, and their anxiety to fulfil and maintain those obligations.

With respect to the removal of the standard, I need only to observe that its maintenance was not obligatory on the Company alone, but conjointly on them and the River Dee Commissioners appointed under the Acts before alluded to; and the Committee have every reason to believe that its disappearance, an event which took place prior to the memory of any now living, arose in part from natural decay in the course of years, and in part from the neglect of the supervisors (also to be appointed under the said Acts) to repair it. They have no ground whatever for conceiving it to have been wilfully destroyed by any party.

The charge "of attending more to the reclaiming and embanking of waste land for their own benefit than to the improvement of the navigation," is best refuted by the fact, that whilst a regular annual expenditure has been incurred, during upwards of a century, in maintaining the present navigation, besides the first large outlay in making the present channel, and besides frequent extra expenses in groins and other improvements, no additional land has been reclaimed by the Company beyond that which the natural action of the tide and sea had rendered fit for being embanked, and the cost of these different embankments bears a very small proportion to the amount expended by the Company upon the river and works of navigation.

The Committee do not deny that by a very large outlay of capital increased depth of water may possibly be obtained, and the navigation of the river Dee and port of Chester improved; but it does not follow that the River Dee Company is bound to make such outlay, and they have very little encouragement to do so from the return realized upon their past expenditure. This brings me to the last charge against the River Dee Company, namely, that of having made a bargain for their own advantage to the prejudice of the citizens of Chester. Upon that subject I have first to observe, that at the time (now more than a century ago) that the River Dee Company undertook the improvement of the river, the various channels through which it then flowed over the estuary had become almost silted up, so that the navigation was nearly destroyed, as is stated in the earliest of the Company's Acts; and the citizens of Chester, not having at that time either the means or inclination to make any efficient improvement of their harbour, certain individuals, afterwards incorporated as the River Dee Company, undertook to do so, on having, as a compensation for the outlay of their capital, a grant of the White Sands, then of no value whatever, with the right of imposing tolls for the use of the improved navigation. Upon this agreement the undertakers laid out nearly 80,000*l.*, a large sum one hundred years ago, in making the present channel and outlet for the river, in lieu of the numerous streams through which the river at that time flowed over the estuary; upon which outlay the original subscribers received no dividend or return for nearly the first fifty years; and those who have since represented them have been receiving a dividend, gradually increasing to 4½ per cent. per annum, which is now at last paid on each 100*l.* of original stock. Had that capital been originally invested at interest in the government funds, or upon mortgage, it would at the end of the first fifty years, during which no return was received upon that expenditure of capital, have amounted to a sum far above the present value of the River Dee Company's estate.

This statement of facts will, it is hoped, be sufficient to satisfy yourself and your colleague that the Company's bargain has not been so highly beneficial to them, nor so very prejudicial to the citizens of Chester, as has been represented.

I do not think it necessary to refer further to the additional outlay incurred by us from time to time, after the original expenditure of 80,000*l.*, in improving and maintaining the present navigation; but I will rest satisfied with assuring you that the River Dee Company has derived no other return from that outlay than the dividend before stated, and such prospect as they have of gradually and slowly, and not without additional expenditure of capital or income, reclaiming further portions of the estuary.

The Committee having considered it proper that you and your colleague should be in possession of these facts, before making any report to Parliament on the subject, no apology can, I trust, be necessary for my troubling you with this communication.

I have, &c.,
W. J. HAMILTON.

Capt. Washington, R.N.

No. 181.

Mr. WEDGE's *Remarks on the Letter of the Chairman of the River Dee Company.*

No. 181.
Wedge, on the Letter of the Chairman of the Dee Company.

SIR, *Sealand, Chester, Dec. 22,* 1845.

In reference to the first point referred to in the Chairman's letter to the Tidal Harbour Commissioners, as to the state of the river having arisen from the neglect of the company, I have to observe that Mr. Telford, for 17 years, from 1817 to the time of his death in 1834, was frequently consulted on the subject, and everything which he, in his reports, recommended to be done for the improvement of the navigation of the river has been done; that his directions have been followed up to the present time; and that, in conformity with his directions, in making jetties to contract the low-water channel of the river from Chester to Connah's Quay, a distance of nearly six miles, and in making a stone causeway of more than 1,000 yards in length, at an expense altogether of nearly, if not quite, 20,000*l.*, for improvements and upholding them, over and above the annual amount of common expenditure. That the tide in the Dee does not rise so high generally as it did formerly, there can be no doubt. When I first came to this place there were five or six Dublin packets (as they were called) that had used to lie afloat at Park-gate at low water, where now, at low water, there is scarcely water enough to float the smallest boat. And under a commission to perpetuate the testimony of old witnesses, held in 1799, it was given in evidence by an old man of the name of Adams, that he had been on board a vessel of 200 tons burthen lying afloat at low water, moored to a stone then called the Coffin Stone, above (that is, on the Chester side) of Burton-head, in a place now covered with confirmed marshland, and where, instead of there being water enough at low water to float a vessel of 200 tons burthen, it requires an 18 feet tide (or thereabouts) on the dock-gates at Liverpool to cover the surface of marsh; and as the whole surface of the estuary has probably proportionably risen, it must be quite evident that winds of whatever force, acting on the surface of deep water, as in 1732, must have had a much greater effect in raising the height of the tide, than when acting on the surface of comparatively shallow water in 1845. Indeed, there are evident traces left of the tide having at some time flowed over the top of the river bank, where in the last 43 years it has but a few times risen so high as half way up the slope of it.

As regards the removal of the Standard, as adverted to by the Tidal Harbour Commissioners, every inquiry that could be made was made, in and about the year 1800, of the oldest persons then living and of those most likely to remember it, but no satisfactory information could be obtained, not even from the supervisor himself, either as to the time of its removal, or how it came to be so. It had been placed on the apron of the ten gate-sluice, and when that sluice, built for a particular purpose, became useless and was taken down, the Standard must have been removed with it, but no person living in 1800, that I could ever meet with, had any recollection of the time.

The payment of river tonnage to the company ceased in 1819; about that time proceedings were about to be taken by the citizens of Chester to compel the relinquishment of it, and it being at that time not thought advisable on the part of the company to contest the point, the tonnage has never since been received, nor the Ellesmere Canal Company called upon for the fulfilment of their guarantee of 235*l.* a-year.

The Standard originally set up was the only guide to know when there was or was not the required depth of water, but that Standard having been lost, the company were called upon to set up a new one, which was accordingly done in 1801 by the supervisor, who had been appointed by the company in 1744, and had acted in that capacity up to the time when the new Standard was set up, the corporation of Chester never having appointed one, as they were directed to do under a heavy penalty for neglect, until the year 1800, when a man of the name of Vazey was appointed.

The new Standard, although set up with the greatest care and attention by the company's supervisor, from a comparison of the rising of the tide on certain fixed, permanent objects, with the rise of it on the old Standard (of 150 tides), between the month of April, 1769, and September, 1775, and afterwards certified by the supervisor on oath, has not even been admitted to be correct by the parties interested in it. The mark of nine feet on the old Standard was intended to denote the height of "a moderate spring tide;" and if the average height of spring tide on the dock-gates at Liverpool, 18 feet 7 inches, (as ascertained by Mr. Dudley Clarke, and my brother, in or about the year 1806) may be considered as the height of "a moderate spring tide," and taking that as a proper rule for judging, there never has been that I am aware of, 12 consecutive months (as required by the Act of Parliament before the corporation can take possession of the company's lands) without the required depth of water, excepting only in the two last remarkably dry seasons. The state of the river even then, if contrasted with that described in the preamble of the Act of 6 Geo. II., was by no means unfavourable.

As respects the enclosure of land originally by the line of new channel, and since from time to time by the company considering the whole as a bargain for themselves, if the aggregate amount of dividends received in the 113 years, 1732 to 1845 (there having been 50 of those years when no dividend was paid), be divided by 113, it will give to the original subscribers about 2 per cent. on their capital. The new channel was not made where it is for the purpose of gaining land, the marsh, all on the Chester side of it, being to be paid for, but because it was not possible by any attainable means to make it anywhere else. The new channel was cut through high marsh land, which required a 20-feet tide to cover the surface of it. If it had been attempted in a straight line to Balcon Point, on sand, it would have been covered by the lowest of every neap tide.

The power which the Ellesmere Canal Company have to take water from Balā Pool (through which the water from the source of the Dee passes) was given to it by an Act passed on the 29th June, 1804, which power was confirmed by another Act of Parliament, which received the royal assent on the 21st June, 1827. The taking of water from the Dee must, whatever the quantity, in some degree have a tendency to lessen the land water's scour of the low-water channel of the river below Chester, but to what extent it is quite impossible to say. It is a point on which there may be, and has been, great difference of opinion. My own, however, is, and always has been, that the quantity taken is not sufficient to have any material effect on the navigation of the river.

I have, &c.,
THOS. WEDGE.

To the Secretary of the River Dee Company.

APPENDIX B.
SALCOMBE.
No. 182.
Evidence taken on the 30th Oct. 1845.

No. 182.

SALCOMBE CREEK.

Examining Commissioner—Captain Sir J. J. GORDON BREMER, R.N., K.C.B., K.C.H.

Lieut. HENRY LEEWORTHY, R. N., examined.—Is a Lieutenant in the Royal Navy, and has commanded the coast-guard station at Salcombe for the last eight years. In addition to that period, had also commanded a revenue cutter for two years previously on the district, and was in the habit of coming into the harbour at almost all times of tide. There is a bar across the entrance composed of sand, in the shape of a ridge, extending directly across the harbour's month. The depth of water on the deepest part at low-water spring tides is from seven to eight feet. There is an equal rise and fall all over the harbour, of from 22 to 24 feet at spring tides. The width of the channel at the narrowest part is at least 300 yards; and the depth of water there at low-water spring tides is 22 feet. Besides the bar, there is the Pound Stone on the west side, lying off the Mault, about 200 yards distant from the land, which is covered only at spring tides. On the east side there is a sunken rock called the Wolf, also about 200 yards distant from the land; these are the only rocks which may be called impediments to the navigation. The Pound Stone is beaconed and the Wolf is buoyed. There are also beacons on the extreme points of two reefs, which project into the harbour from the main land on the west side, and are dry at low water. These buoys and beacons were placed, and are maintained by subscriptions of the shipowners and inhabitants of Salcombe and Kingsbridge generally. The town council of Dartmouth have the jurisdiction or controul over the waters of the estuary of Kingsbridge and Salcombe; but they have not visited the harbour since he had been stationed there; nor have they ever subscribed towards the maintenance of the beacons, or otherwise towards the improvement of the harbour in any way. Does not actually know, but has every reason to believe they levy dues on the shipping frequenting the port and on goods landed. The Port of Salcombe is capable of containing 500 vessels with ease, in water varying in depth from 22 to 40 feet at low water; and is a safe harbour for a disabled vessel to run into for shelter. Vessels in distress frequently seek refuge in it; has often heard masters of vessels say after they were in, that if they had not been ignorant of the existence of so good a harbour, they would more frequently have sought shelter there. From half-flood to half-ebb, a period of at least six hours, there are more than 16 feet of water on the bar. Southerly gales produce the heaviest sea, particularly from half-ebb, but it never is a very heavy bar sea, in consequence of the formation of the bar itself, which is not more than 12 feet in width at its widest part; has sounded frequently on every part of it with a line, and bored it with a sharp rod. There are no regular pilots attached to the port of Salcombe. Considers it absolutely necessary, to render the approach safe at night, that a light should be placed on the tail of the Blackstone, a ridge of rocks on the east side of the channel, which forms an excellent breakwater to the harbour; recommends the removal of the Pound Stone and Wolf rocks, as well as the extreme points of the projecting reefs on the west side, on which beacons now stand, with which material he would fill up the eastern channel which is now quite useless. This latter plan would cause a considerable increase to the scouring power in the main channel, and very probably deepen the water on the bar. Considers that these improvements may be carried into effect at a trifling expense compared with the advantages which would be gained. No changes have taken place in the harbour with the exception of the eastern channel, which has filled up and become useless within the last eight or 10 years. Is not aware of any encroachments having been made on the shores of the harbour. Considers that the interests of the shipowners and of the public generally, as connected with the port, would be benefited by the appointment of a harbour-master intrusted with its controul and management. Has frequently known considerable obstruction and much damage to be caused by vessels improperly anchoring in the thoroughfare of the harbour; also from the lime-stone, which is brought here in large quantities, being thrown overboard in the navigable parts of the harbour, where it remains in heaps frequently for several tides to the great interruption of the navigation. Considers that all these inconveniences arise from the want of some competent authority to check them.

Mr. GEORGE ENGLAND, principal Coast Officer, Landing Waiter, and Tide Surveyor at Salcombe, examined.—Has known the Port of Salcombe 12 years and upwards. Has an account of the shipping entering the port for three years, ending 5th January, 1845. [Produced the account]. There are no pilots belonging to the port.

The Town Council of Dartmouth hold a lease from the Duchy of Cornwall, under which they levy dues on coal, culm, and bricks brought coastwise, and on foreign and colonial timber. The rate on coal and culm is ¼*d.* per ton. Not acquainted with the amount of dues on the other articles.

The Town Council have never contributed to the improvement of the port in any way, nor to the erection or maintenance of beacons and buoys. The beacons and buoys in the harbour and in the channel were erected and are maintained at the expense of the shipowners and inhabitants of Kingsbridge and Salcombe, who subscribed for the purpose. In the event of damage or accident, another subscription is resorted to. The removal of the Pound Stone, Wolf, and Old Harry Rocks, which might be effected at a trifling expense, would render the harbour a very good one, especially if the eastern channel, which has now become useless, were filled in. Important benefit would also be derived from a light being placed on the end of the Black Stone. The shipowners and public in general would be benefited by the establishment of a harbour-master. Has known frequent instances, in which much damage has arisen from vessels improperly anchoring in the fairway of the navigation and remaining unmoored; there being no person having authority to compel them to moor. Thinks also, there ought to be a proper establishment of licensed pilots belonging to the port. There are now none but hovellers. The largest vessel witness remembers to have entered the port was a deeply laden collier of 450 tons burden, drawing 18 feet of water. There is now building a brig of 250 tons new measurement. There are vessels constantly being built in all the yards. The returns will prove that the exports and imports are considerably on the increase.

Appendix B.

Salcombe.

No. 182.

Evidence taken on the 30th Oct. 1845.

An Account of the number of Vessels, with their Tonnage, and the number of Men they employed, that have entered and sailed from Salcombe Creek, during the last three years ended 5th January, 1845, exclusive of Limestone Vessels and Fishing Craft, decked and open.

	INWARDS.			OUTWARDS.		
Date.	Number of Vessels.	Tonnage.	Men employed.	Number of Vessels.	Tonnage.	Men.
1842	266	13,051	1049	296	12,230	1007
1843	245	12,446	983	300	12,400	987
1844	261	12,863	986	234	9,215	781

The number of vessels which entered and sailed from Salcombe Creek, during the year ending 5th January, 1845, was 943, of which 10 discharged Cargoes from foreign, and 9 carried Passengers, Baggage, and Mails.

On the 5th of January, 1845, the number of Vessels, the amount of their Tonnage, and their value belonging to Salcombe Creek were as follows:—Vessels, 67; Tonnage, 5,396; Value 27,600*l.*

George England, *Principal Coast Officer.*

The Amount of Corporation Dues collected at Salcombe Creek, during the three years ending 5th April, 1843, 1844, and 1845, was as follows:—

1842-43	1843-44	1844-45
£. *s.* *d.*	£. *s.* *d.*	£. *s.* *d.*
62 17 2	67 6 2	60 19 0

John Wilmot, *Receiver.*

Dartmouth.

No. 183.

Evidence taken on the 3rd Nov. 1845.

No. 183.

DARTMOUTH.

Examining Commissioner—Captain Sir J. J. Gordon Bremer, R.N., K.C.B., K.C.H.

Mr. Arthur Bailley Harris, Mayor of Dartmouth, examined.—The Town Council are the conservators of the port and river. Their jurisdiction extends to a place called White Rock, about a mile below Totness. The authority under which they exercise this jurisdiction is by lease on lives from the Duchy of Cornwall, one of which only remains. An Act of Parliament was passed some years since for embanking a portion of the river near Totness, for the purpose of narrowing the stream and deepening the river. It has had the effect of deepening the water a little. Is not aware of any other embankment or change in the course of the river or its banks. The best mode of improving the port and harbour would be to station a light near the Castle. There was an application made to the Trinity Board on this subject, and the town-clerk, who is now present, will produce the correspondence. Under power of the lease dues are levied on the shipping; the town-clerk will produce the accounts. Refers for any further information to the town-clerk, who is in full possession of all documents on those points; also to the harbour-master and branch pilots in attendance.

Mr. Henry Petherbridge, shipowner, examined.—Has been acquainted with the port of Dartmouth for 60 years. In consequence of an Act of Parliament obtained for deepening the river from Totnes four miles down, the bed of the river was disturbed, and a settlement took place about two miles below the point at which this deepening ceased, forming a bank in some places 20 yards wide, and causing a reduction in the depth of water of two feet, thereby greatly obstructing the navigation in that part, but does not think that it has had any injurious effect on the harbour. Owns four ships sailing out of the port. The following are the dues levied upon shipping:—Sixpence per vessel for passing the Castle, paid to the gunner stationed there, and 6*d.* per vessel for anchorage; 1*s.* for groundage alongside the quay, and 2*s.* 6*d.* for groundage on the graving-bank, paid to the town council of Dartmouth. Considers that an improved light at the Castle would be very desirable. There is a light there now, but it is not a good one. There should be buoys placed on the Home Stone and Cheek Stone, both sunken rocks, also on the outer edge of the eastern ledge. These are the only dangers in approaching the harbour. The light is maintained by the corporation, assisted by voluntary subscriptions of shipowners and others, but the corporation are not bound to maintain it. At present there are neither buoys nor beacons of any kind to assist in the navigation of the port. Good anchorage extends upwards from the harbour's mouth about three miles, with from 10 to 12 fathoms water.

William Palfray, Branch Pilot, examined.—Has been a pilot 26 years. No change has taken place in the depth of water in the harbour, nor have any obstructions occurred, except that there is a bank below Kitting Point, which has two feet less water on it than it had 20 years ago, but it is not an obstruction to the navigation. There are six branch pilots belonging to the port. The best mode of improving the approach to the harbour would be to place a *proper* light on the Castle, which would enable vessels to run for the harbour at all times. The light now there is uncertain. Would also recommend a buoy to be placed on the Home Stone and a beacon on the Cheek Stone. The last is dry at low-water. A buoy on the Eastern Ledge is very necessary; it is the principal danger in entering. I have known vessels to run over it at high water without knowing it, and be in great danger. Had there been a buoy, they must have seen it. The rise and fall at spring tides is generally from 14½ to 15 feet. There are six feet at low springs on the Eastern Ledge and on the Home Stone.

Commissioner.—Is the harbour accessible at all times?—Unless the wind is fair, ships anchor in the Range, outside the harbour's mouth, and there they wait for the tide. It is a safe anchorage.

Richard Lamball, examined.—Was master of a vessel trading out of Dartmouth for 30 years. There ought to be buoys on the Home Stone and Eastern Ledge, and a beacon on the Cheek Stone. A good

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DARTMOUTH.

No. 183.
Evidence taken on the 3rd Nov. 1845.

light on the Castle would be of great advantage. Many a dark night, when running for the port, has wished for one there; it would be the best position to clear all dangers. Is not aware of any changes having taken place in the harbour.

Mr. WILLIAM PROUT, Solicitor and Town-clerk of Dartmouth, examined.—The Town Council are lessees of the office of water-bailiff of the port and harbour of Dartmouth, and of the jurisdiction of the river extending to a place called White Rock, about a mile below Totness. They hold the lease under the Duchy of Cornwall. They have power to levy customary dues on shipping discharging cargoes, also certain dues on anchoring in the port. The principal dues are those received on coal and culm, one halfpenny per quarter, equal to about three halfpence per ton. The port of Dartmouth extends from Torquay eastward to Shallowborough, in Bigberry Bay, thus including Brixham and Salcombe. No particular portion of the dues is devoted to the improvement. The whole amount is carried to the general credit of the borough-fund, out of which the expenses of maintaining the quays and of the present light at the Castle are paid; also of providing the gear for weighing the different articles imported upon which dues are received, as well as the salaries of the different receivers. The corporation do not maintain any buoys or beacons in the approach to the harbour. The corporation pay 12*l*. or 14*l*. a year rent to the Duchy of Cornwall, and they paid 90*l*. for the renewal of the last life. They pay 15*l*. a year to the harbour-master. An Act of Parliament was obtained some years since for deepening the river below Totness, which interfered with the rights of the borough of Dartmouth so far as this, that a tax is levied on all goods landed within the limits of the Act. Before, it was free. We did object to the Act of Parliament, and in consequence an exemption from the toll was made in favour of a certain class of boats which had been in the habit of using the river for five years, which period has now expired, and now the toll falls on all alike. It is generally considered to have injured the trade of the port, and is inclined to think that it has done so, from the decrease of the amount of dues. The lantern for the light on the Castle was originally presented to the town by the late Sir John Seale, in 1836, before which time there was no light. It was then maintained by subscription of the ship-owners and merchants, the consent of the Trinity Board having been first obtained for its erection. About three years afterwards it fell into the hands of the corporation, the subscriptions having failed. It has since then been wholly maintained by the corporation. They are not bound to do so; indeed, they intend to withdraw their support, and have intimated the same to the Trinity Board.

ESTIMATED Average of Dues received by the Corporation of Dartmouth in the last five years from the following places, viz.:—

	£.
Salcombe	50
Torquay	45
Brixham	22
Dartmouth	165
	£282

The annual expenses, including rent to the Duchy Commissioners, to receivers, superintending and providing weighing gear, &c., for all the creeks, amount to about 30 per cent.

W. PROUT, *Town-clerk.*

AN ACCOUNT of the Number of Vessels entering the Port of Dartmouth in each of the Years 1836 to 1844, both inclusive, with the Number and Tonnage of such as have broken bulk, and how many have entered the harbour in each year for refuge.

Years 1836 to 1844	Total Number of Vessels.	Number of Vessels broken Bulk.	Tonnage of Vessels broken Bulk.	Number of Vessels entering the Harbour for Refuge.
1836	1,214	572	42,817	642
1837	1,054	472	34,826	582
1838	1,278	490	28,241	788
1839	1,219	428	27,939	791
1840	1,168	415	29,049	753
1841	1,121	362	25,467	759
1842	1,138	368	27,455	770
1843	1,337	353	25,340	984
1844	1,199	364	24,532	835

Custom-house, Dartmouth, 4th November, 1845.

The number of vessels and their amount of tonnage registered at this port are as follows:—Vessels, 442; tonnage, 30,090.

J. MOODY, *Collector.*
J. H. SPARKE, *Comptroller.*

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Evidence taken on the 5th Nov. 1845.

No. 184.

EXETER.

Examining Commissioner—Capt. Sir J. J. GORDON BREMER, R.N., K.C.B.

JOHN GIDLEY, Esq., Town Clerk of Exeter, examined.—The town council of Exeter have the controul of the river Exe and port of Exeter. As early as the 31st Henry VIII., an Act was passed enabling the corporation of Exeter to keep the river clear and remove nuisances therein. It is called "An Act for the mending of the river of Exeter." These powers were continued to the corporation by Act passed in 1840, a copy of which I now present.

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No. 184.

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In 1825 an embankment was commenced, for the purpose of forming the extended line of the Exeter canal, from a place called the Lower Sluice to another called Turf, immediately adjoining the estuary of the Exe. This work was completed under the authority of an Act of parliament obtained for the purpose. In the year 1839, a person, by name Gilbert Perriam, erected a wharf or quay immediately above the ancient quay at Topsham, projecting into the tidal way of the river, and between high and low water mark, without any authority whatever, and without notice to the Admiralty, as required by the 46th Geo. III., cap. 153, and in defiance of the remonstrances of the corporation. This wharf now stands, and has the effect of creating a deposit round the upper part of the old quay. The next encroachment, which is likely to be of serious injury, is the embankment under the South Devon Railway Act. This embankment enters the tidal water considerably above Star Cross; below that village it is carried farther out into the waters of the estuary, whence it extends to the sea, and encloses in its course a large space of land outside the ancient high water mark, thus excluding a great body of tidal water, as will be seen by reference to the plan I produce. [Producing plan].

The corporation of Exeter petitioned the House of Commons against this bill, and supported their opposition by counsel and witnesses before the committee of the House. They stated eight objections; five were of a public nature, and three had reference to the injury their property was likely to sustain. I submit a copy of these objections. The engineer employed was Mr. James Green, a copy of whose opinion and report, and also a map of the river Exe, I now produce.

The port of Exeter extends from the easternmost bank of the river Exe, at the extremity of the county of Devon, eastward, to the west bank of the river Teign, westward. With respect to that part of the port which lies between the city of Exeter and the Cheek Stone Rock, outside Exmouth, the petty customs have been equalised, and a summary remedy given for their collection by the Act of 1840 before mentioned. Commissioners are appointed with power to raise money, and to apply certain sums, which vary from one to two hundred pounds per annum, for the purpose of keeping the river clear, which they effect by mechanical means.

There are no sums applied by the corporation of Exeter expressly for the purposes of the navigation of the river. They pay a certain sum to the Commissioners under the Act, as before stated.

[Witness handed in a copy of Mr. Walker's report to the Lords Commissioners of the Admiralty, with reference to the South Devon Railway.]

Mr. RICHARD BUSSELL examined.—Is a corn and coal merchant, and one of the Commissioners of the river Exe. There are four Commissioners elected by the inhabitants of Topsham, who are rated at £12 per annum to the poor, and also by the owners and part owners of ships belonging to the port. Three other Commissioners are appointed by the town council of the city of Exeter.

Within certain boundaries, namely, from a place called Newland to the Fairway buoy, at Turf, we have power to dredge the river. We do this by a barge with hand power only. It is of no service at all, the power being insufficient; it rather does injury, by making holes or pits in the bed of the river. We hava only £100 a year allowed us to carry on the dredging. We received the sum of £500 when the Act was first obtained; which sum was devoted to the purchase of the barge and necessary gear.

Has been acquainted with the River Exe for forty-five years. Is now in the coal trade, and charters about twenty sail of vessels annually. Is thoroughly acquainted with the river, from Topsham down to Exmouth. Off Star Cross the sands have shifted within the recollection of witness, causing changes in the channels, but believes the depth of water to be much the same.

There was an embankment made about twenty years ago by Thomas Hall, Esq., between Exmouth and Lynepstone, by which he enclosed between 70 and 80 acres over which the tide used to flow; but believes that he had no authority for making this embankment. There is also at present in course of construction the South Devon Railway, which takes in a large portion of the tidal water on the west side of the river, and which is likely to cause most serious injury. Is not prepared to say that the navigation of the river may be seriously injured, but is quite sure the shipping interests will be so by the loss of the coasting trade. Already has the establishment of the railway to London most seriously affected the shipping interests of the port, and in proof thereof can mention his own case. Before the Bristol and Exeter Railway opened his sale of coals alone amounted to nearly six thousand tons per annum: it is now reduced to one thousand. Used to employ twenty sail of ships a year; navigated, probably, by 150 men. Now five ships, not employing more than 40 men, are sufficient for his trade. The trade of almost all the other coal-dealers is reduced in the same scale.

The bar is buoyed, and the river also as far up as a place called Nob. Considers these buoys quite sufficient. The buoys are maintained by the Trinity Board. There is no light, but thinks that a light would be of the greatest consequence to the port. Witness would be very glad to contribute to its maintenance by the payment of a small due levied for the purpose on vessels entering, and is almost sure he can answer for the captains of vessels frequenting the port. At present the bar is much obstructed by the wreck of a vessel of about 35 tons, laden with lime-stone. There is a buoy on the wreck; it has been there nearly twelve months. Is not aware of any steps having been taken to remove this wreck. Believes that no change has taken place in the bar and the depth of water, but the pool sands to the westward of the bar have increased within the last 25 years very much, and have narrowed the channel. The depth of water over the bar is from 18 to 20 feet at high-water spring tides. The rise and fall of tides are from 13 to 14 feet springs, and 8 or 9 on the neaps. The generality of the traders that frequent the port are from 130 to 150 tons; I have known vessels of from 400 to 500 tons come as far as a place called the Bight, which is in the river. There is no harbour-master. There is a regular establishment of branch pilots. Does not consider the number sufficient for the trade, from the constant complaint of the masters of the vessels consigned to witness. The masters say that they rarely find a pilot when they want him; that they are frequently on the bar before they are boarded by the pilot. Has known masters to refuse a charter to Topsham in consequence of the known inattention of the pilots of their port. The navigable distance from the bar to Topsham is between seven and eight miles. Is not aware of any good chart of the port having been published. There are three ship-building-yards in the river; one at Exmouth and two at Topsham. There are regular pilot-vessels, smacks of from 25 to 30 tons, fine vessels, capable of keeping the sea in all weathers. The depth of water generally in the Bight is 30 feet at high-water spring-tides; in the upper part of the river from 11 to 12 feet. The method to improve the river and port would be by a steam-dredge, to remove a bank called the "Muscle beds off Powderham," which is formed of clay, easy to be removed. We might get from 15 to 16 feet at high-water, instead of 12 or 13, as at present; this would enable vessels to go up to the mouth of the Exeter Canal, and clear

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the lower part of the river, instead of being detained, as they frequently are, by this bank. Above this there are many obstructions, which might all be removed in six months by a steam-dredge; enabling vessels, which are now often detained a fortnight waiting for the tide, to get up to Topsham-quay. Despatched one of his chartered vessels yesterday, which had been detained a fortnight. Thinks 14 feet or more might be obtained. The Commissioners are empowered by the Act of Parliament to sell the ballast dredged up, devoting the amount to the purposes of clearing the river.

	£.	s.	d.
In the year 1842, 3,751 tons of ballast were sold, producing	109	8	3
,, 1843, 4.130 ,, ,,	106	15	5
,, 1844, 7,685 ,, ,,	192	2	6
,, 1845, 3,185 tons up to 31st August . . .	78	17	6
Balance in hand on the 31st August	£77	13	11

The nature of the trade carried on in the port is principally coasting, but we have also occasionally ships from the Baltic, from America, and other foreign parts. There is no fishery carried on in the port. The qualification necessary for a Commissioner of the port is to be a ship-owner, or part owner, or a rated inhabitant of Topsham to the amount of 12*l.* a-year to the poor. He derives no emolument from the office.

Mr. HENRY TROAKE, Clerk to the Commissioners, produced the accounts of the Commission, and verified the same as stated above.

No. 185.
Green, on Encroachments on the Estuary of the Exe by the South Devon Railway.

No. 185.

Mr. JAMES GREEN'S *Report on the Encroachment on the Estuary of the Exe by the South Devon Railway.*

London, 29th April, 1844.

I CONSIDER that the making any embankments within the estuary of the River Exe will, by abstracting tidal water, greatly lessen the power of that water to keep down the bar at the entrance of the harbour, and to keep open the navigable channels in the estuary.

It can be proved that embankments which have been already made have been the cause of great accumulations of mud and silt, by which the tidal waters have been lessened; as, in the case of the embankment at Exmouth, the one near the Retreat, and in extending the Exeter Canal from near Topsham to Turf.

The line of railway as laid down encroaches on the estuary on the west side to a considerable extent, to the amount, as calculated, of 60 acres; but it is said that, if "even this space were filled in solid from the shore to the railway, the depth is so small, and the site so near the mouth or bar of the river, that no sensible injury could be done to the back-water," and this, although it is stated that, in one place, the railway is 80 yards distant from the shore: at Cockwood, it measures on the map no less than 200 yards; and, if the line of deviation be acted upon, it may be at this point no less than 300 yards, or 900 feet (and this is a most important part). It is not therefore easy to say what may be the average depth of the water that will be excluded; but I know that, although the shore to a considerable extent is flat, there is at high spring tides not less than 5 feet of water against the wall in front of the Powderham grounds, and also against the wall from Starcross to Cockwood, and, at the Cockwood Point, there is 9 feet of water at such tides. From this point there is, for some distance, a flat beach as far as Dr. Drury's wall; against this wall there is frequently 5 feet of water. From thence to the Warren there is no wall, excepting the hedge-banks on the land side of the road, which runs along the verge of the beach; these banks are faced with stone, and I have known them frequently thrown down by spring-tides.

It is said that the tidal water excluded from the estuary may be compensated by taking the earth for the embankments from the shore; if these excavations are made in pits, as they generally are, it will produce no such effect; for they will be quickly filled with water, and in that state they will remain; and, by the current of water along the shore, they will soon be filled with mud and silt. It seems also to be considered that the tidal water which is excluded will be of the less importance from its being so near the mouth or bar of the river. The bar of the harbour is, however, between 3 and 4 miles below Starcross, which is about the central point of the embankment; I consider, therefore, that any abstraction of tidal water in the estuary must diminish the weight and column of water acting on that bar, both in the flood and ebb of the tide, and, as such, must be prejudicial to the navigation of the estuary. It must be admitted that the greatest scouring power of back-water is between the first and last quarter of the ebb-tide; without a transverse section of the bed of the estuary, with the heights of tide upon it, I cannot pretend to say precisely what portion of the tidal water abstracted will fall within those limits, but I can safely say it will be at least two-thirds of the whole area at spring-tides.

The altered state of the entrance to the estuary from what it was 30 years ago makes it the more necessary to preserve every possible extent of back-water. The entrance channel is now nearly four times its former width; the force of water passing in and out of the estuary is therefore greatly lessened, and the repeated breaches made by the sea in the sand-banks on the shore called the Warren have greatly contributed to this effect, as well as to render what is called the Bite, in the lower part, and on the west side of the estuary, much less safe than formerly for vessels of a large class to lie in; and I think it may be proved by old and experienced pilots, that vessels which, 30 years ago, could pass the bar and lie in safety in the Bite, cannot now do so; and, from all these circumstances, I consider the town council of Exeter, interested as they are on public grounds in preserving the navigation of the estuary, are justified in their endeavour, if possible, to prevent the abstraction of any tidal water whatever.

The next point, viz., the height at which it is proposed to construct the embankments for the railway, is one in which the corporation may not be so immediately interested, but it may be right for me to advert to it. It is proposed 4 feet above high water of spring-tides; this will be only about the height of the present sea-walls where they exist, and certainly not as high as extraordinary spring-tides. I have frequently seen these walls overflown by the tides, the roads obstructed, and the banks greatly damaged. I therefore consider the proposed height very insufficient, and that, in any case, a parapet wall of not less than 6 feet high will be necessary to protect the carriages on the railway from winds, as well as waves; this is, I think, a matter for grave consideration by the promoters of the Bill.

JAMES GREEN.

P.S. By a careful measurement of the map which I have received, I find that the area of water which will be excluded between the shore and the centre line of the railway (independently of deviation), is not less than 80 acres, and I think that it may fairly be considered that more than 50 acres of that area will be within the first and third quarters of ebb and flood on a spring-tide.

APPENDIX B.

NEWCASTLE.
River Tyne.

No. 186.
Evidence taken on the 3rd Nov., 1845.

No. 186.

PORT OF NEWCASTLE—RIVER TYNE.

Examining Commissioners—AARON CHAPMAN, Esq., M.P., and Captain WASHINGTON, R.N., F.R.S.

Present—A. L. POTTER, Esq. (*the Mayor*); Aldermen LOSH, G. T. DUNN, T. DUNN, HODGSON, CARR, and NICHOL; Councillors PHILIPSON, WEATHERLEY, HARLE, CRAWHALL, JOBLING, FINLAY, ARMSTRONG (*Chairman of the River Committee*), LOWREY, ORMSTON, H. TURNER, A. PARKER, JOHN NICHOL, HUNTER, DODDS, HAWTHORN, CARR, BARGATE, INGLEDEW, and KEENLYSIDE; Mr. JOHN CLAYTON (*the Town Clerk*); Mr. W. ARMSTRONG (*the Treasurer*); and Messrs. MATTHEW PLUMMER, WILLIAM STOKER, GEORGE STRAKER, W. WOODS, JOSEPH PEASE, jun., ROBERT INGHAM, JOHN JOBLING, WILLIAM KELL (*Town Clerk of Gateshead*); ROBERT ANDERSON, DREWETT BROWNE, WILLIAM RICHARDSON, JOHN DRYDEN, THOMAS BELL, JOSEPH STRAKER, JOHN STRAKER, W. A. BROOKS (*River Engineer*); EDWARD GRAHAM, JOHN RAYNE, GEORGE BURNETT, jun., JOHN HARLE, R. GRANGER, C. SMITH, jun., &c.

[*Mr. Giles's large plan of the River Tyne, on a scale of twenty inches to a mile, made in* 1813, *was laid on the table.*]

The TOWN CLERK stated that the corporation of Newcastle were the conservators of the river. Their authority was held by prescription, founded on an assumed previous grant from the Crown, and regulated by Acts of Parliament as to particular points. By an Act of 1837, they levied town and quay dues. These dues were collected long before, but were reduced by the Act to cheapen the port. They had power to maintain quays, and did so. A considerable sum of money had been recently expended in constructing a new quay, in extension of the old one. Sheds had been erected on the quay. The Improvement Act (lying before the Commissioners), gave power to lay down a railway on the quay, but none had yet been constructed. The most important item of revenue was, a due of 2*d.* per ton on all coals exported from Newcastle; it was formerly 5*d.*; but in 1792 a London alderman went to law with the corporation, and it was reduced to 2*d.* Freemen were exempt from dues. This privilege would expire with the freemen who were in existence at the passing of the Reform Bill.

Mr. WILLIAM ARMSTRONG, borough treasurer, stated that the accounts were published annually, and produced several annual statements.

The COMMISSIONERS, on examining the accounts of the year ending August 31, 1843, observed that the river had yielded a revenue of about 20,000*l.*, and it did not appear to him that more than 1300*l.* had been expended in river works.

It was stated, however, that money had been disbursed for quays, &c., which was not included in this sum; and the treasurer undertook to prepare a statement, relating to the river alone, which should show the exact amount of revenue and expenditure in the last seven years respectively.

The TOWN CLERK observed, that the mass of the receipts of the corporation involved no obligation to improve. They were subject to the burdens of a county. They were bound to maintain a quay at Newcastle, and upwards of 6000*l.* had been devoted to this purpose in one year. This included the purchase of property. The debt of the corporation is 10,000*l.* It was partly incurred before the passing of the Municipal Act, and money has been borrowed under the Town Improvement Act, for public purposes, for widening the street, and for markets, &c. We have enlarged and improved our property, and have ample means to meet our obligations. The annuitants, too, are fast dying of. The interest is paid out of the general revenues of the corporation, amounting to upwards of 40,000*l.*, one half of which is derived from the river. The main item of river revenue is a town due on coal—a tax on the coal owners. Could not levy that due if the coal were conveyed from the district by railway. The coal must go on the river, or we cannot collect the due.

Mr. W. A. BROOKS, resident engineer of the port of Newcastle, stated that he had held his present appointment three years. He had formerly been employed at Cork, Waterford, and Stockton-on-Tees. These were the principal places at which he had been professionally engaged. There was one general and leading principle which he had found applicable to the improvement of navigable rivers—namely, the bringing of the flood and ebb tide into the same channel. My first acquaintance with the Tyne was in 1832. There was then a bad shoal at Tyne Main, with only two feet at low water of spring tides. Small boats got aground there. It was removed by my predecessor, Mr. Anderson. The river was narrowed in the vicinity by quays. A new quay, of a solid construction, had been built near the town, on the north side of the river, nearly extending to Ouseburn. Several reports had been made on the river. The first by Mr. Rennie, in 1810, after a survey under his direction by Mr. Francis Giles. Mr. J. Richardson and Mr. Cubitt had also made reports. None of the reports had been acted upon until within the last few years. The shoal already referred to was left undisturbed. A report made by himself, a few years after he came to reside in Newcastle, had been partially carried out, and improvements were in progress. He had recommended the construction of jetties on the concave shore, where the river was too wide; in the bight, for instance, above St. Peter's, and also in the bight above Bill Point. The most important one was below Walker, where the river expanded to a great extent. All the engineers recommended the enclosure of the river by jetties at this point. He had run jetties out at right angles, and the enclosed space was in process of being sanded up, and becoming dry land. It filled up at the rate of (say) two feet in a year, and would be dry land in about four and twenty years. His plans contemplated the enclosure of the estuary to the extent of about 200 acres—three-fourths of which, or thereabouts, would become dry land. This area has an average depth of two yards over it at high-water springs; the process of warping would, therefore, exclude one and a half millions of cubic yards of water on every spring tide. The tide would continue to flow over the rest. The rise of water at the bar was about 16 feet, and at Newcastle Quay 11. Mr. Rennie proposed to enclose 448 acres of the estuary, but he did not think it necessary to enclose so much. The construction of works on the concave

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shore would answer every purpose. The deepening of the channel would compensate the exclusion of the tidal water from the enclosed estuary. He anticipated bringing 14 feet of water to Newcastle Quay. There was now a greater difference than there should be, between the depth on the bar and the depth at Newcastle. The difference in depth at the bar and up the channel was the test of the condition of a river. The corporation had ordered the execution of works at Jarrow, to serve the same purpose as jetties (to bring the flood and ebb into the same channel). There were no shoals now, with only two feet water. There were some with only three—none with only two. On Hebburn Shoal there was not more than three feet water. In the channel generally, at low-water, there was from six to eight feet.

COMMISSIONERS.—Then are we to understand that in the best navigable channel of the River Tyne—a river yielding a revenue of 20,000*l.* a year, and on which reports have been made from time to time all recommending improvements—you have, at one point a depth of only three feet at low-water?

MR. BROOKS.—It is so.

COMMISSIONERS.—And would there be any difficulty in deepening the river?

MR. BROOKS.—None whatever. It is simply a question of expense. The shoal might be removed by jetties. To dredge would be a waste of money. A large sum had been spent in dredging, a few years ago, to remove this shoal, but without success. He was quite satisfied that it might be sent away in three months. He had reported to the River Committee on the necessity of removing it.

Below Killingsworth Staiths, three-quarters of a mile east of Hebburn Shoal, is the next worst part of the channel. There, at the east end of the old Cockraw Sand, there was but three feet of water. Two years ago there was but two. Works were now in progress which would further increase the depth. The jetties had answered their intention. Opposite the Cockraw Sand, there was a depth of from 11 to 5 feet; in some parts 12 to 13. When the jetties were lengthened, there would be 12 feet where now there was but 2½. This was a great advantage. Vessels would lie afloat where before they lay aground. In many parts of the Tyne vessels could lie afloat at low water. A great proportion of the vessels in the river could do so. The Tyne offered great advantages to shipping. In most parts, vessels could lie afloat at the staiths. Owners, of course, wished their vessels to be water-borne. He had not heard many complaints from ship-owners. Had heard of no vessels being sent to other ports, because they could not lie afloat in the Tyne. Many came to the Tyne because they could not lie afloat elsewhere. His (Mr. Brooks's) plans were founded on the construction of jetties on the concave shore. There were some staiths on the convex shore, but they were chiefly on the concave. Staiths, injudiciously constructed on the convex shore, had injured the navigation; the staiths, for instance, at Cobble Creek, erected many years ago. Staiths were never put up without the leave of the corporation. He knew of none that were injurious, erected within the present century. Some had been beneficial, and had eased the expense of river improvements to the corporation.

The greatest obstacle to the free flow of the tide—the greatest blot on the navigation of the river—was Tyne Bridge. There was deep water below the bridge, and shoal water immediately above. The number of the piers was unnecessarily large, but the uncalled-for bulk of the starlings was still more objectionable. The tide flowed nearly ten miles above the bridge. It was then impeded by a bed of gravel, which crossed the river. If this were removed, the tide would flow much higher. There was a depth of 11 feet at Newcastle, and of nothing at the point in question (Hedwin streams, the western limit of the conservatorship). A greater body of tidal water might be made to flow up the river; but its tortuous course, above bridge, offered great obstructions. There was a railway bridge across the river at Scotswood, some miles above the bridge. It had been constructed, however, very judiciously, and presented the least possible hindrance to the tide. It was built by Act of Parliament, and with the sanction of the Admiralty. Had not heard of keels being "wrecked" against it; but sometimes, when not keeping a good look-out, they ran foul of the piers. The depth of water in the river was more due to freshes than to the tidal scour. Both were requisite, but the freshes more especially. They were very strong in the Tyne. The detritus which they brought down was carried out to sea. He did not believe that any portion of it lodged on the bar. The corporation had a steam-dredger of twenty-two-horse power. They formerly had two, but one had been sold. Dredging was of little use in the Tyne. The bed of the river was sand. He had bored in many parts, and found only sand or silt. The bar was also sand. There was a notion that a ledge of rock formed part of the bar, but he believed this to be erroneous. If it were true, it would certainly be very desirable to use every possible means to remove the rock. There was a difference of about an hour in the tide at the bar and the bridge. Tidal observations were of great value. None were kept in Newcastle. Nothing would sooner point out the effect of improvements. The difference of time in the flow of the tide, on the bar and at the bridge, should be shortened. The distance being only ten miles, there should not be a greater difference than a quarter of an hour; and there ought to be much more than 11 feet water at Newcastle, when there was a depth of 16 feet on the bar. There were no other circumstances, save the obstructions which existed, to account for such a state of things; and these obstructions might be materially diminished. The bends obstructed the tide. There were rivers which had more water ten or twelve miles up than at the bar, as the Orwell and the Thames, and all well conditioned rivers. Fourteen feet might be got at Newcastle Quay. Some quays on the Tyne were not so deeply founded as to admit of this. His quays were founded with this view—on piles. So also the new quay, built by Mr. Anderson. His improvements would not bring down Tyne Bridge.

COMMISSIONERS.—When on the river, we observed a ship of about 1400 tons on the stocks. If you were the owner would you feel satisfied of there being water to carry her out to sea?

MR. BROOKS.—I should rather doubt it. We have no self-registering gauge as at other ports, and as even in the dry harbour of Scarborough.

Mr. Brooks produced his plan of docks on the Black Middens, and of a pier to extend into 15 feet of water at low tide, 500 feet beyond the bar. The bar (he said) was a ridge of sand, without shingle, about 600 feet in width. He thought the pier would deepen the water on the

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bar three feet. The pier would cost 70,000*l.*, if stone had to be brought from the country; but if the docks were constructed, more stone would be excavated than would build the pier. He did not think the pier would obstruct the flood tide.

Mr. RICHMOND.—I think the pier would prove impracticable; and if practicable, mischievous.

Mr. THOMAS BELL.—If the pier were built, you couldn't hold a ship in the harbour, the range of swell would be so great.

Mr. DREWETT BROWNE laid before the Commissioners a plan of docks on the west side of Jarrow Slake.

In a conversation which ensued, it was stated that an Act of Parliament had been got for docks on the east side of the slake. No act would be needed, said Mr. Browne, for docks on the west side, if leave were granted by the corporation; but the Commissioners remarked that they had not the power to give any such leave. The slake could not be enclosed without the permission of the Admiralty.

Mr. BROOKS stated that Jarrow Slake was very shoal. He did not think it would be prejudicial to enclose it. This was the opinion of many persons, very many, besides himself. The area was about 350 acres. The depth at high-water, over all, would not average six feet.

Mr. BROWNE.—In my opinion, it is is silting up very fast.

Mr. ROBERT ANDERSON examined.—The pier proposed by Mr. Brooks would prevent the flood tide coming in, and prove injurious to the harbour. A ship could not enter with a scant wind from the north. He would oppose the erection of a pier either on the one side or the other. [Mr. Anderson produced a plan of the proposed docks, on the east side of Jarrow Slake.]

Mr. BROOKS, as an engineer, saw no objection to the plan.

Mr. GLYNN, of the firm of Laws and Glynn, solicitors, produced a plan of docks at Coble Dean.

Mr. BROOKS admitted that the Trinity House of Newcastle disapproved of his plans at Dent's Hole and Tyne Main; and he also stated that the quay at South Shields was carried out from 20 to 30 feet farther than his predecessor had proposed. This, he explained, was to bring it into the general range of the concave shore. The deviation was made with the sanction of the River Committee and the Council, and on the report of other parties.

Mr. WILLIAM RICHMOND.—The in-sand varied in height; for sands took liberties of this kind, rising, and falling, and shifting, by a sort of whim or caprice. He did not think they were affected by any of these filchings from the Queen's highway (as the Commissioners had very properly called the river), which were continually going on in the present day. Sometimes, by freak of nature, there was more water here, and sometimes more there—now the channel was on this side, and now on that. He did not believe the new-fangled encroachments of the corporation had much to do with it. Of late years, there had been an alarming decrease of water in Peggy's Hole, the only good mooring-place for men-of-war in the harbour. He recollected the "Regulus" lying afloat there half a century ago. There was then a depth of 24 feet: but not more now than 16. He attributed the decrease to the erection of a coal-staith, where none should ever have been tolerated. There was, he believed, as much water in the harbour now as at any time, and as large a number of berths—perhaps more. The carrying out of Whitehill Point had improved the harbour. Both the old corporation and the new, in my opinion, have given too great facilities to encroachments. In the more serious cases the consent of the Admiralty should be necessary; before erections are permitted. The Tyne would do very well if it were let alone; but it is dying of the doctor. I cannot say they are not the same as Mr. Rennie's—modified; but the Tyne, I admit, is in a better condition than it was. Still, the river has worsened since they began to tamper with it. In my opinion, you can no more remove the shoals out of the Tyne, than the planets out of the spheres. Even if you were to narrow it into a ship-canal, you would have the same amount of stuff coming out of the mountains, and the channel would be choked. It is not a fact that loaded colliers can now lie afloat where formerly they could not. On the contrary, loaded colliers could formerly lie afloat where now they cannot. If you have got new berths at Wallsend, you have lost old ones. If you make the river into a canal, you will ruin it.

The "Smith's Quay" controversy, which so long distracted the Council, was now revived.

The COMMISSIONERS, after hearing observations from Alderman Dunn, Councillor Lowrey, Mr. George Straker, Mr. Brooks, and others, remarked that they could not undertake to settle in five minutes a question which had been debated for years. It appeared to them that Mr. Walker, the Admiralty engineer, had enjoyed the fullest opportunity of forming a right conclusion; and having consented to Mr. Brooks's line, it was evident that he thought it a safe one. All that they could say was that they hoped they would proceed cautiously, and not go too far out. They would also strongly impress upon the corporation, not only with respect to this, but to all quays, to take care that slips and landing-places were secured to the public at proper intervals. It was especially important in cases of accident on the water; for with a long line of quay, without landing-places, the risk of drowning was greatly increased.

Mr. STRAKER declared that the whole town was opposed to Smith's Quay.

The COMMISSIONERS.—How can you make such an assertion, Mr. Straker? Two-thirds of the town-council have voted in its favour, and the burgesses elect the council. How, then, can it be said that the whole town is against the quay?

Mr. STRAKER.—I meant the whole town with the exception of the council.

Mr. CHAPMAN.—I am not acquainted with Messrs. Smith, nor can I pronounce any opinion upon their line of quay; but I must say that Newcastle has seldom experienced a greater benefit than in the establishment of their building-yard on the Tyne, and the corporation should feel bound to grant them every proper facility.

Mr. HENRY TURNER produced a plan for the conversion of Ouseburn into floating docks.

Mr. SIMON DANSON, harbour-master for the last eleven years, stated that he was bred on the Tyne, and had been 43 years at sea. He was sorry to say he had seen no improvement in the river of late

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years. Considerable improvement had been made at the end of the jetties, but not elsewhere. There was not room for two vessels to pass each other. Whatever additional depth had been got was owing to the dredger. Vessels (continued Mr. Danson) sometimes broke away for want of moorings. The old quay was not a deep-water quay. Guns were used, in preference to rings, for moorings. He was sorry to say too much ballast was thrown into the river. Little was done in the way of prevention. The authorities, indeed, should first reform themselves before they interfered with others. What the engineer took out at one place he threw in another. He deposited below high-water mark what he dredged up from the bed of the river; and a considerable portion of it was washed back again.

Mr. **Brooks**.—It is deposited out of the action of the tide.

Lieut. **Collins**, of the Coast Guard, Howdon, spoke in corroboration of the engineer's statement.

Mr. **Brooks** observed, that to land the stuff from the dredger above high-water mark, as suggested by Mr. Danson, would be very expensive and very unnecessary. None of it washed back into the river.

Alderman **Dunn**.—And were any other person to do this, would he not be fined?

Mr. **Lowrey**.—Why there is a by-law allowing manufacturers to deposit what they choose between the jetties at 2*d*. a ton!

The **Commissioners** made a remark implying their opinion that the stuff from the dredger should be deposited above high-water mark.

Mr. **Danson** (in continuation).—Much ballast was thrown overboard from vessels within the prohibited limits, and wrecks sometimes occurred in consequence. Four steamers traded from Newcastle to London, Leith, and Hull. There had been a dredger in the port six or seven years. The old one was little used; they said she wasn't right. She was changed because she could not dredge alongside the quays. The new one could, and had got more depth. The old one cost 2500*l*., before she was laid aside as useless. In dredging, clay and gravel were brought up, as well as sand. The dredger should be used on Hebburn Shoal.

Mr. **Brooks**.—It was used there for three months, and brought up 20,000 tons of sand. The labour and cost were just thrown away.

Mr. **Danson** admitted that in some places the river had been improved, but he would give none of the credit to the "new-fangled" ways.

Mr. **John Rayne**, deputy-master of the Trinity House, stated that they had a gross annual revenue of about 6000*l*. About 2000*l*. was applied to buoys, lights, &c., and the remainder to charitable purposes. He saw no objection to the formation of docks at Jarrow or Coble Dean. The slake was silting up. He hardly thought that docks at Ouseburn would be of any advantage. The new quay had given great facilities to shipping at Newcastle. The river generally, in his opinion, should be embanked. The Master and Brethren of the Trinity House were opposed to the engineer's line of quay at St. Peter's. He anticipated no difficulty in carrying out the new system of examination for masters and mates. The Trinity House had made arrangements for its adoption.

Mr. **Lowrey** suggested that the Trinity House, if it did not abandon, might reduce its primage. The dues, however, he admitted, were generally moderate at Newcastle; they were less than at other ports.

Mr. **Richmond**.—It is the cheapest port in the country, with the exception of Milford Haven. It is the cheapest in Europe, and almost the best.

Mr. **Thomas Smith**, river pilot, stated that no depth of water had been gained in the river. There was less than there was fifty years ago. The pilots were complaining to him every week of the danger there was in taking down ships. Tyne Main Staiths was the only place at which any improvement had been made. Generally, the river had changed for the worse. Larger vessels came up to Dent's Hole formerly than could come now. The vessel in which he served his time came up to the hole, drawing 15 feet. Tyne Main Shoal had been improved, but that was owing to a new quay. Quays may improve the navigation, and he would approve of quays, judiciously built, and not going too far out.

In reply to further questions, Mr. Smith stated the results of soundings recently made, to show that no depth of water had been gained; but the soundings had not been made by himself, nor under his observation, neither had any observer watched the tide-scale while the soundings were taken.

The **Commissioners** observed that soundings taken in so loose a manner might do very well for piloting a ship up or down the river, but they were far from being accurate enough to test a slight improvement in a river.

Mr. **Joseph Straker**, of North Shields, stated the want of dock accommodation. He had known a loaded ship towed to the mouth of the harbour in search of a berth, and brought back again, west of Shields, because none could be found. Moorings had long been wanted, and were now to be laid down under an Act of Parliament, the ship-owners having consented to be taxed for this purpose. Dock accommodation was absolutely necessary for the trade of the port. This was the feeling of the great bulk of the people of Shields. There were differences of opinion, perhaps, as to the proper site. He was inclined himself to Jarrow Slake. It was so far grown up, that the water was not of much consequence. Docks at Coble Dean would be useful, or at the Black Middens. He thought, also, that Mr. Brooks's pier would improve the bar. As to depth of water, he did not believe the river had improved in the last half century. There might be as much water as formerly, but the channel had been so narrowed that ships could not be got up, if it were not for steamers.

Mr **William Kell**, town-clerk of Gateshead, called attention, among other things, to the fact that few public landing-places, and no public quays, were provided by the conservators of the river, except in Newcastle, although their revenues were derived from the various communities dwelling on the banks of the river.

In conclusion, the **Commissioners** impressed upon the corporation the importance of having a new survey of the river, that the question of loss or gain of depth might not be left in doubt.

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Rennie's Report on improving the Tyne.

No. 187.

Mr. RENNIE'S *Report on Improving the River Tyne.*

London, 17*th June*, 1816.

THERE is, perhaps, no river in Great Britain on which it is more difficult to give a satisfactory opinion, as to the best mode of improving its navigation, than the river Tyne. In this river not only is great depth wanted, but likewise great width, to accommodate the immense number of ships which resort to it; these two qualities, however, are incompatible with each other. If the width of the river were to be contracted by a solid embankment, its depth would be increased, but then the space for the accommodation of shipping would be lessened; and, as a less quantity of tide water would thereby be admitted, it would have less effect in keeping down the bar; but this is not all—for when ships are working into the harbour with an adverse wind and flowing tide, there would be less current to carry them across the bar, so that in gaining depth of water in the channel of the river, care must be taken that the depth on the bar be not diminished. A solid embankment on the side of the river must, therefore, be avoided, or at least limited to a certain extent, and other means devised to effect the object; but to both there is a limitation, and, therefore, it becomes a nice point to settle with precision what depth can be obtained and maintained in the river Tyne, between its mouth and Newcastle Bridge, without contracting it to a degree that may prove materially injurious to the navigation.

From the very correct survey of the river Tyne, within the limits I have specified, and of its mouth, made by Mr. Giles in the year 1813, and also the soundings and sections taken by him, it appears that on the 30th day of May, 1813, being the second day after new moon, the rise of tide, from low water to high water, at Shields was 14 feet 11 inches; at Hebburn Quay, the same day, it was 12 feet 5 inches; at Newcastle, 11 feet 8 inches. The second day after the first quarter, being the 7th of June, it rose 9 feet at North Shields, 8 feet 2 inches at Hebburn Quay, and 7 feet 7 inches at Newcastle. The second day after full moon, being the 16th of June, it rose 12 feet 7 inches at North Shields, 10 feet 8 inches at Hebburn Quay, and 10 feet 2 inches at Newcastle Quay. The second day after the last quarter of the moon, being the 23d of June, it flowed 11 feet 3 inches at North Shields, 10 feet at Hebburn Quay, and 8 feet 8 inches at Newcastle.

When the first and second observations were made, the wind was easterly, and blew fresh; when the observations after the full moon were made, it blew a strong northerly wind; but when the last observations were made, it was nearly a calm.

Many other tides were observed, as will appear by the sections or tables, which accompany this report; from the inspection of which, it will appear that many of them differ considerably from those I have described. Taking, for example, the second day after new moon, on the 30th of June, when the weather was moderate, the rise was 15 feet 2 inches at North Shields, 12 feet 2 inches at Hebburn, and 11 feet 3 inches at Newcastle: the neap, on the 7th of July, at North Shields, rose 8 feet 7 inches, at Hebburn Quay 8 feet 2 inches, and at Newcastle 7 feet 3 inches.

From the first set of observations I have stated, namely, the 31st of May, it appears that the rise at North Shields was 2 feet 6 inches more than at Hebburn, and 3 feet 3 inches more than at Newcastle; from the second observations, on the 7th of June, it appears that the rise was 11 inches more at North Shields than at Hebburn, and 1 foot 8 inches more than at Newcastle: from the third observations, on the 16th of June, the rise at North Shields was 1 foot 11 inches more than at Hebburn Quay, and 2 feet 5 inches more than at Newcastle; and on the 23d of June, the rise at North Shields was 1 foot 3 inches more than at Hebburn Quay, and 2 feet 7 inches more than at Newcastle. Thus, the difference on these four respective tides at North Shields and Newcastle, was 3 feet 3 inches, 1 foot 5 inches, 2 feet 5 inches, and 2 feet 7 inches. But the tide of the 30th of June, when the weather was calm, the difference was 3 feet 11 inches; the quantity of tide water thrown into the Tyne at each tide therefore varies exceedingly. This variation depends not only on the state of the tides themselves, but on the winds and on the quantity of fresh water which is in the Tyne itself; this renders it exceedingly difficult to draw any correct inference from calculations founded on data so very variable. It appears, from the observations made on the tides by Mr. Giles, for about four months, that the average rise of springs at North Shields was about 14 feet; at Hebburn, about 11 feet 10 inches; and at Newcastle, about 11 feet 7 inches; thus making a difference of rise, between North Shields and Hebburn Quay, of about 2 feet 5 inches, and of Newcastle 2 feet 8 inches. The average neap tides, for about the same period, flowed at North Shields 8 feet 10¼ inches, at Hebburn Quay 7 feet 9½ inches, and at Newcastle Quay 7 feet 2¼ inches; thus making a difference of rise, between North Shields and Hebburn Quay, of about 1 foot 1 inch, and of Newcastle of about 1 foot 8 inches. The tide observed on the 31st of May, though not an average spring tide, as it rose 14 feet 11 inches, is that which was taken as a data for all the soundings marked on the plans. This was done to save time; for had the soundings been delayed until the average spring tides had been ascertained, a principal part of the summer would have been lost. From the soundings, it appears that the whole quantity of water in the Tyne, between Shields Narrows and Newcastle Bridge, at the low water of the 31st of May, 1813, was about 214,262,000 cubic feet, and that at high water on the same day it was about 940,883,000, thus leaving 726,621,000 cubic feet for the quantity of tide water thrown into the above district. The velocity of the current of the flowing tide in springs, above Shields Narrows, is about 3 knots per hour at half flood; and about half ebb, the current is about 3½ knots per hour. The width of the river is, however, so very various, that the rate of the current varies in almost every part of it, and is generally the greatest when Jarrow Slake is just covered, which is a little before half flood. Vessels entering the harbour at this time frequently derive advantage from this great expanse; for if they enter with an adverse wind, the increase of current helps them over the bar, when they otherwise would not be able to enter the harbour at all. This slake is of great extent, covering upwards of 350 acres, and when the water is covering it, there is an increase in the velocity of the current of nearly one quarter of a mile per hour, an increase of material advantage to the shipping; and indeed it forms a considerable portion of the area of the river between Shields Narrows and Newcastle Bridge, the whole of which, including this slake, is about 1694 acres at high water. Although a great extent of space to receive tide water is essential to the preservation of a good outfall, it must be observed, that the most advantageous space for the reception of this tide water is not the surface exclusively, which is in a considerable degree the case with the Tyne, where there are large sand banks, which are not covered with water until nearly half flood, after which the water has not so great an effect in scouring the bottom as at an earlier period of the flow; the like takes place in the ebb. In the Tyne, the sand banks are so numerous and high, that the flood is far advanced before they are covered with water, and, therefore, the current of the tide is sluggish; and, besides, the numerous eddies in the river greatly obstruct the flow. In like

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manner one-half the ebb is fallen off before the sand banks are dry, and by the time when it should be the greatest, its scouring force is in a great measure gone by, there being little water left in the river. Were the sand banks removed, and the tide had free ingress, it would flow with more rapidity in the first quarter of the flood; and in like manner it would return with more rapidity in the last quarter of the ebb, so that in both cases it would scour with more force, and make and maintain a greater depth of water. The time for which vessels could navigate the river would likewise be prolonged, and they would sooner get to their berths when inward bound; and in like manner would proceed down the river and get to sea before so much of the ebb was spent. To effect this essential improvement, I propose that the river shall be contracted in its wide places into a narrower channel, and in places where the width is already too small, it shall be enlarged; in doing these the curves must be made as uniform as the nature of the shores will admit, and that wherever there are any abrupt projecting points, which materially obstruct the current, that these points shall be cut off. The lines of contraction laid down by me are not, however, regular—they are always wider where the turns are; and, in general, the river has been laid out of a greater width where the greatest number of vessels generally lie, in order that proper room may be afforded for others to pass and repass them. And as vessels, which lie in the river to take on board cargoes, not only occupy considerable space, but also occasion eddies, there is more space required for the tide water to pass them, than in places where vessels do not generally lie. It is possible, however, that experience may prove that these spaces should be still further contracted. The mode of contracting the river, where required, I propose to be the same as that practised in the river Clyde, which, with the addition to the plan suggested by me about eight or ten years ago, has proved so very successful, namely, by building jetties from each shore, and moving the sand and gravel out of the intended channel, by means of dredges, and depositing it in the spaces between the jetties, and when the channel was brought near to the depth it was expected the water would maintain, these jetties have been joined by walls of rubble stone, whereby the channel has been preserved of a regular depth. Without these junction walls this could not have been done, as the water would have spread between the points of the jetties, and thrown up sand banks, which would thus have rendered the channel full of shoals. By the line of jetties laid down me, the surface of the channel, supposing the tide to be confined within these points, will be reduced to about 896 acres, namely, 448 acres less than it now is at high water. Now the question is, how shall this deficiency of tide water, occasioned by the contraction, be supplied? Towards the supply of this deficiency there are several sand banks in the channel of the river, which are now dry at three quarter's ebb, and there are others which are nearly dry at half ebb; of the former, are those at Jarrow Sands, amounting to about 21 acres, and of the latter, are Cock's Crow Sand, and several others, amounting to about 52 acres, making together about 73 acres, which will be reduced to a depth considerably under low water. In addition to this, I have to remark, that the river throughout (I mean the contracted channel) will be very much deepened, and consequently the low water will be depressed in its surface; and as the flood tide will be much less obstructed, it will flow further up the Tyne, and rise higher than it now does. And as it will receive the tide water in the first quarter flood, and will retain this water until the last quarter of ebb, it will produce a much greater effect in scouring the bar in proportion to its quantity than it now does; and in addition to all these, it is proposed that the height of the jetties shall little exceed the height of half flood, so that a principal part of the space embanked will still remain as a receptacle for tide water. According to this plan, therefore, the scouring effect of the tide will be materially increased, and consequently the depth of water over the bar will be increased to the depth, I apprehend, of at least two feet.

The narrowing the river by means of jetties is the most economical mode I can devise, and best suited to the circumstances of the case, for that part of the river which lies between Shields and Newcastle, but for the whole length of Shields, and most of Newcastle, I am of opinion the contraction should be made by regular wharf walls of masonry; and as the space gained will prove highly beneficial to the proprietors of property bordering on the river, I cannot for a moment doubt that they will be ready to make an allowance for the ground gained, if not to undertake the work at their own expense.

In some parts of the river the channel will require to be widened, such as at Whitehill Point, at Bill Point, at Hall & Co.'s lead smelting works, at St. Anthony's village, at Felling Shore copperas works, at Cinder Kilns, at Friar's ballast hills, and opposite the Northumberland glass houses, at the head of the Glass House Reach. By the cutting of these projections, the tide water will meet with much less interruption in its flow, and the freshes of the river will meet with less interruptions in going off, and spread more regularly over the channel, so as to scour away the sand banks which now lie irregularly in the river, and thereby make and maintain a more uniform depth of water.

I have laid down the line of the channel which I would recommend to be edopted, and also the situation of the jetties which appear to me to be the best; but it is by no means unlikely that, in the course of executing the work, it may be found convenient to alter the places of several of the jetties to render them more suitable to the coal staiths on the sides of the river, several of which will require to be altered, and this will be attended with considerable expense; for I am of opinion, that if inlets or mud docks were to be made at these staiths, they would, in a short time, be sanded up, and thereby rendered useless, and wet docks at the respective staiths would be too expensive; so that, under all the circumstances of the case, it appears to me it will be better to lengthen or shorten the staiths, to render them suitable to the new intended channel of the river, than to adopt any other mode.

In regard to Jarrow Slake, I propose that it shall be left open as it now is; but to prevent this sand from being carried into the channel, it will be necessary to make a kind of flat facing of rubble stone, to admit of the tide passing over it, and to prevent the sand from running into the channel upon the tide's ebbing from its surface, and indeed to preserve the channel along its edge, without which it could not be kept in its place.

Having now given my opinion on the best mode, as it appears to me, of improving the navigation of the river Tyne, between Shields Narrows and Newcastle Bridge, I shall next consider the best means of improving the entrance; but before I lay down my plan for this purpose, it will be necessary to state how the tides act on the mouth of the harbour.

The current in the offing begins to run to the northward about three hours after high water, and continues to do so until about three hours after low water, thus making a northern current about five hours; it then sets to the south, and continues in that direction until about three hours after high water, making a current to the south of about seven hours. But in-shore the change of current is different, for it makes to the south about a quarter of an hour after low water, and it begins to move towards the mouth of the harbour about 35 or 40 minutes after low water, and continues to run upwards

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for about five hours, and ebbs about seven hours; but if there is a strong fresh in the river, it is frequently half an hour later, and then it does not run upwards more than four hours.

In the making tide, when the current runs to the south, it sweeps round the head at Tynemouth Castle; and as the point of the Herd Sand is covered with water early in the flood, a cross current is formed at the Narrows, which throws a part of the tide over to the Low Lights shore, while another part continues its direction upwards; by this cross current the bank, called the Middle Ground, is formed. There is another sand bank, called the In-sand, which unites with the tail of the Middle Ground, and this sand renders the access to the harbour difficult, it not being an easy matter for a ship moving with so rapid a current as there is in the Narrows to avoid it. If these two banks were removed, the access to the harbour would be much more easy and safe, for in this case vessels would run boldly for the harbour, which they cannot do at present: but an evil would arise out of this of considerable extent, namely, a heavy swell run into the harbour in strong easterly gales, as the waves would then have nothing to check them, and this would be attended with some danger to the shipping within. The total removal, therefore, of the Middle Ground and In-Sand is not what is wanted; but a partial one, so as to render the access easy, without admitting too much swell into the harbour. Nothing can exemplify this more strongly than the case of Aberdeen harbour, which, in the year 1769, was in a great measure similar to the harbour of Shields. There was a projecting rock, called Gudleness, on the south, and a long flat sandy shore on the north, from which a point projected and formed a narrow mouth; there was a middle ground, and what may be called an in-sand: the entrance was shallow, and ships lay in safety within the harbour, but the access was difficult. Mr. Smeaton's opinion was taken, in the year 1770, on the best mode of improving this harbour, and he recommended a pier to be built on the north side, to prevent the seas from running into the mouth of it, where they not only occasioned great agitation, but also brought in large quantities of gravel and sand. This pier was found to answer the purpose of deepening the entrance, but it also removed the sand point, or ness, which formerly checked the in-run of the seas, and by this removal such a swell got into the harbour in easterly gales, as to occasion great damage to the shipping. Mr. Smeaton was therefore consulted again in the year 1788, when he advised that a jetty should be constructed where the old sand, Ness Point, formerly lay, to turn the waves into a different channel: this was done, and it effectually answered the purpose. Such an example ought not to be lost sight of, as it proves that a similar measure, with certain modifications, may be resorted to with safety in this case; and should it even turn out that the Middle Ground and In-sand shall be scoured away, and the sea in easterly winds run with violence into the harbour, this can be prevented by a jetty properly constructed, so that no fears need be entertained of the ultimate success of the measure.

The situation and extent of a southern pier is, however, a matter of serious consideration. It should not be placed too near to the channel, as in this case it will not afford sufficient room for the free entrance of the tide, nor should it be placed too far from it, lest the cross current should not be sufficiently checked. I have placed it in the situation which appears to me the best; but should you determine to carry the measure into execution, it can be then set out with all due attention to the circumstances of the case. I have not laid down any plan for dry or wet docks, which may conveniently be constructed on the sides of the Tyne; but if you should adopt the plan I have recommended, these may be done at a future period.

With respect to the expense, it is no easy matter to be correct in a work of this nature and extent: I have, however, endeavoured to make out an estimate as near as I can, amounting to £519 320. This estimate is made on the supposition that the whole work shall be done out of the fund which may be raised for the works; but as I have before given it as my opinion, that the stone walls, or wharfing, in South and North Shields, should be done in part, if not wholly, at the expense of the respective proprietors opposite whose property the new wharf walls are to be made (the earth or sand, to fill the spaces between the wharf walls and the land, should be provided at the expense of the harbour and navigation fund, because the removal of the sand is necessary to give depth of water in the river), this would occasion a saving of upward of £80,000, and would reduce the estimate to £439,320. The works I have proposed are, in many cases, of a nature that do not require to be immediately carried into execution, and, indeed, it would be injudicious to do them so if even they could.

Where the channel of the river is to be materially changed, it should be done gradually; for if it were done otherwise, the sudden effect produced would greatly impede the navigation. The new proposed wharf walls in Shields may also stand over for some time to come, unless the proprietors of the property on the borders of the harbour think it advisable to commence upon them at an early period, which it would be their interest to do. The works that strike me as most material to be done first, are those which tend to direct the river in a straight, or, at least, an uniform course, where it is most interrupted by sand banks. The effect of such works will be sooner felt than in other places where the channel is not so bad; and the pier on the Herd Sand is a material object. On this subject, however, I shall be more particular, should my plan be determined on to be carried into execution.

I am, &c.,

JOHN RENNIE.

To the Worshipful the Mayor, Aldermen, and
Burgesses of Newcastle-upon-Tyne.

Estimate of the probable expense of the works proposed for the improvement of the navigation of the river Tyne and Shields Harbour.

	£.
To a pier on the Herd Sand*	218,011
To a new wall from Half Moon Stairs to Bottle House Landing, including filling the space within	115,762
To a new wall from Walton's Salt Works to the south end of the High Docks, including the filling of the space within	12,430
To a low rubble stone causeway across the entrance to Jarrow Slake, for the water to pass and repass freely over it	5,106
Carried forward	351,309

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* Mr. Giles, civil engineer, under date of the 17th of February, 1836, estimates the expense of this pier at 50,000*l.*

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	£
Brought forward	351,309
To building twenty-one low jetties between Jarrow Slake and Hall & Co.'s Lead Works, and dredging sand from the channel of river	13,407
To cutting off a projection at Hall & Co.'s Lead Works	3,300
To building eight small jetties between Hall & Co.'s Lead Works, and Messrs. Brandling's Coal Staith	684
To cutting off projection at ditto and at Goose Quay	12,622
To the building of five jetties between Goose Quay and Ballast Hills	537
To cutting off projections at Ballast Hills, and at a place above	7,512
To the building five small jetties	390
To a new quay wall from the Low Lights Shore, in North Shields, to the Steam Mill, including the filling the space within	34,110
To building four substantial jetties along the Droitwich Sand to near Whitehill Point	2,316
To cutting away Whitehill Point and sands at ditto	6,702
To the building of thirty-one jetties between Whitehill Point and Bill Point, and dredging the sand from such projections as required	18,500
To cutting off the projection at Bill Point	16,630
To building six jetties between Bill Point and St. Anthony's Village	1,068
To cutting off projecting land at St. Anthony's Village and Cinder Kilns	23,683
To ditto at St. Peters Quay	920
To building six jetties at Newcastle Quay	630
To altering coal staiths and other landing or shipping places; these articles I only guess at, but say	25,000
Total	£519,320

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No. 188.

Mr. RICHARDSON'S *Report, on Improving the Navigation of the River Tyne.*

Newcastle-upon-Tyne, 13*th of* 7*th Month*, 1834.

GENTLEMEN,

Agreeable to your request, communicated to me by your secretary, in a copy of your resolution of the "21st of May, 1834," I have bestowed great attention on the subject of improving the navigation of the river Tyne, and beg leave respectfully to report to you my opinions on the subject:—First, as to the possibility of improving the navigation from Wincombe-lee to Hay-hole; and, secondly, as regards the whole river from Newcastle to Shields.

After mature consideration, it appears to me, that by adopting certain measures, the depth of water may be increased, and the sand-banks and other obstructions removed to a considerable extent, at a comparatively slight expenditure.

Before proceeding to state to you the remedial plans by which I propose to achieve this important and very desirable object, you will, perhaps, allow me to observe, that a general survey or view of the river suggests the natural causes which have produced the present obstructions, and the remedies to be applied to remove them.

The present appearance of the river clearly indicates that it has been increasing in superficial area for many years by the washing and falling down of the banks on both sides. As the surface was thus enlarged, the depth of water has been necessarily diminished by lessening the force of the tidal current, and thereby causing permanent depositions of sand and other materials in the bed of the river. I am confirmed in this view of the subject by the concurrent testimony of several respectable and intelligent gentlemen, who have been intimately acquainted with the river for many years, and also by that of the pilots and watermen with whom I have conversed on the subject.

Presuming, therefore, that I am correct as to the cause of the obstructions which now exist in the bed of the river, I feel little or no difficulty in recommending to you the partial adoption of the plan proposed by Mr Rennie, in 1816. for narrowing the river by the judicious erection of quay-walls. I say the *partial* adoption of Mr. Rennie's plan, because I do not conceive that, at present, it would be either prudent or needful to incur the great expenditure, which carrying all his plans into execution would cause. Although I generally approve of his plan. there are parts of it, the benefits accruing from which would, in my opinion, be extremely problematical—as, for instance, his mode of building the quay-walls, and his erection of a pier at South Shields.

It does not appear to me needful to enter more minutely into the reasons which have induced me to recommend to you the contraction of the river, after the very full report of Mr. Rennie, but I may, perhaps, be allowed to state why I differ from him in the plan he recommends to be followed in the building of the walls.

He proposes to effect this object by the erection of jetties, connected by dwarf walls, to the height of half flood only, on the supposition that otherwise the admission of tidal waters would be impeded, if not lessened.

The obvious disadvantage of this plan is, that the land inclosed would still remain unavailable for building or other purposes, whereas if the walls were built above flood height, the proprietors of the adjoining properties would, I have no doubt, in most instances, if not in all, be willing to build the walls at their own cost, were they permitted to have the land or quayage thus made.

By the calculation which I have made from measurements, taken from Rennie's plan, it appears that the quantity of land hereafter proposed to be enclosed will be fully compensated for in the sectional area by the removal of the land and other existing obstructions. I, therefore, think Mr. Rennie has over-rated the probable increased quantity and velocity of the tides upon which he speculated, when he proposed building the jetties and walls only half flood high, and cannot see sufficient reasons for expending such large sums without the advantages in return which building the walls flood high would give.

The walls ought to be built on one general plan, from which no deviation ought to be allowed, and the section of the wall to be vertically sloped on the face either in a curved or straight line; the thickness of the wall ought to vary according to its situation and height, and every care taken that the

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foundation be well and securely laid; the space between the wall and the back ground ought to be filled up with either the sand dredged out of the river, or the materials excavated in making the improvements herein recommended. Where quays or walls now exist, and which are not in accordance with this plan, either by their irregular lines, projections, or indentations, they ought to be removed and rebuilt in a proper manner, so that they may not act, as some now do, as quoins and mud-bays to the interruption of the current.

In a few situations it may be prudent to erect jetties, but as the wall will be above flood height, the general adoption of them will be unnecessary.

I do not see that I can improve upon the line of walling laid down by Mr. Rennie, nor do I think it very material at what place it is first begun, so long as it is built continuously, that is, without much time intervening between the erection of one part of a wall and that of another part, especially where the river is considerably contracted.

Presuming that the proprietors of the adjoining properties will be at the expense of the walling in front of their respective premises, I have not estimated it, as the cost of it will depend on its situation and height, but it may, I think, be built for twelve shillings per superficial square yard, as an average price for the whole distance. Dredging in the mode I propose would cost five pence per cubic yard; the quantity required to be moved in this way cannot be estimated, inasmuch as we must not only anticipate a moving of the sands, but also an increasing diminution of them by the gradually acquired additional force of the current.

Although thus contracting the river would, undoubtedly, increase very considerably the scouring effect of the tides, yet this would be insufficient to remove in any short period the immense deposits now existing, and recourse must therefore simultaneously be had to artificial means until the channel was considerably cleared. This would, I think, be best effected by employing a steam dredging machine, at so much per cubic yard for the quantity, &c., dredged and deposited in such places as the might be, from time to time, pointed out. This could, I think, be done at the price named, as the places of deposit would be contiguous and easily accessible, especially if the dredging machine were to empty its work into keels fitted up with boxes with trap-bottoms, and a crane sufficiently powerful to lift the boxes out of the keel on to or over the wall, where the sand was required to back the walls or fill up the spaces between the wall and the original back ground.

In the works I have suggested as likely to be beneficial to the navigation of the river from Wincombe-lee to Hay-hole, I have included the contraction of the stream for the whole distance, although it is a question for your consideration, how far it would be expedient to erect all the walls (especially those on the slake at Cock-crow sand, and opposite to Jarrow sand, on the north side of the river, which are 9,500 feet in length, and from 700 to 800 feet in the broadest points of contraction), without parties are willing to undertake them on the conditions already mentioned.

From the good that has resulted by building the quay at Tyne Main, there can be little or no doubt, but that generally even a partial adoption of this plan will tend materially to the improvement of the river, although this improvement would certainly be greater and more complete if the whole was executed.

With these observations, I shall close my report on the river from Wincombe-lee to Hay-bole, and proceed to consider on more general grounds, what alterations can be made in other parts of the Tyne, so as to give increased facilities to its navigation and greater effect to the plan already proposed. It appears to me requisite, that the proposed improvements ought not to be limited to any particular locality, inasmuch as even supposing the remedies proposed to be adopted, the traffic on the river would still be exposed to inconvenience and loss, so long as other obstructions to a good navigation continued to exist. I make these remarks with a reference more particularly to the projections at Friar's Goose and Bill Point, than which there are no obstructions of this description that more urgently require removal. At Friar's Goose, the buildings which have been erected on the projecting land are of such a description as to entail so great an expenditure on their removal, so as to carry into effect Mr. Rennie's plan, that I have not ventured to anticipate that such a course would be pursued were I to recommend it. I have, therefore, confined myself to what I have considered practicable, and suggest the propriety of cutting off down to low water mark the extreme projecting point, which is a quay, and upon which a crane is now fixed, and to substitute for it another quay, a little more to the west, by building a connecting wall at the outside of a triangular space in the river. Thirty-three feet, at the least, might thus be obtained from the extreme point, and the whole quay rendered less angular, at a cost which I have estimated at 1,078*l*.

Bill Point is, however, of the greatest importance, both as regards the accidents and loss which have occurred in consequence of it, and of the expenses necessary on its removal.

The channel of the river below the point is extremely narrow, there being scarcely room for two ships to pass each other, and above it a like inconvenience and danger arise from ships lying in that situation, and the inability of the parties coming up the river to see the course they ought to take to avoid collision and consequent damage. I know of no particular obstruction more decidedly prejudicial to the commerce on the river than this one, and, therefore, most strongly, but respectfully, urge upon your consideration the expediency of its removal. I have taken the needful levels on the line proposed by Mr. Rennie, and I find, on a liberal calculation, it might be removed to the extent be proposes, and excavated to the depth of low water mark for 11,600*l*.

If this sum should be deemed too large to be expended on this object, a more circumscribed line might be adopted, and the expense reduced accordingly.

It is true, that any measure having for its object the removal of this point, however limited in its extent, cannot but prove highly beneficial, yet so convinced am I of the great importance of this subject, that I should feel dissatisfied with myself were I not earnestly, but very respectfully, to advocate its entire removal as laid down in Mr. Rennie's plan.

Whether this be effected at once, or one part now and another part after the lapse of time, becomes a question of comparative expense, as to which mode will be the cheaper, and there can be no doubt entertained by persons at all acquainted with the description of the work, but that it will cost much less for the whole to be done at once than at several times.

After the decided opinion I have expressed as to the propriety of contracting the river from Wincombe-lee to Hay-bole, according to the lines laid down by Mr. Rennie, it is unnecessary for me now to say more than express my approval of his plan for the whole river, with the exception before mentioned. I agree with him, that it is most important that the river should be made of as equal and uniform a breadth as is consistent with its natural formation, and that all angular points jutting out into, or receding from it, ought to be widened, and that, in fact, all interruptions of whatever description to the

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free ingress and egress of tidal waters, ought to be sedulously guarded against. This can be best done by the plans I have proposed for the part of the river between Wincombe-lee and Hay-hole, and by widening other parts of it, and having recourse to the artificial means of a powerful dredging machine.

It is unnecessary for me to trespass upon your attention by dwelling upon those particular places, where either a contraction or enlargement of the present boundaries of the river are recommended by Mr. Rennie, as he has sufficiently dwelt upon these in his very able report, in which suggestions I cordially agree; but it appears to me that that part of the river which extends from Newcastle to Jarrow Slake, demands the first attention, as it is in the worst state, and of course capable of the greatest improvements.

In conclusion, I beg to observe, that I am under great obligations to your Sub-Committee, who twice accompanied me down the river, and for the important information they communicated, which I gratefully appreciate.

If you wish for a more detailed report, I shall feel a pleasure in furnishing you with it, but, as a general one, hoping this to be satisfactory to you,

I am, &c.,
JOSHUA RICHARDSON,
Member of the Institution of Civil Engineers.

To the Joint Committee of the Common Council and the
Chamber of Commerce of Newcastle-upon-Tyne.

No. 189.
River Improvement Sub-Committee's Report.

No. 189.

Official Report of the River Improvement Sub-Committee, appointed by the Corporation and the Chamber of Commerce, Newcastle-upon-Tyne.

Newcastle-upon-Tyne, 16*th June*, 1834.

WE, the undersigned Members of the River Improvement Sub-Committee, appointed by the Corporation and the Chamber of Commerce of Newcastle, having, agreeably to our instructions, surveyed the river Tyne, from Newcastle Bridge to Hay-hole, with Mr. Joshua Richardson, civil engineer, beg to submit the following observations on the present state of the river, together with such suggestions as we think best calculated to improve its navigation gradually, and at an expense which may be commensurate with the probable funds that may be reasonably expected to be available for this important object.

On duly considering the natural formation of that part of the river to which our attention has been directed, and the various changes, remote and recent, which have been produced by natural and adventitious causes, which are still in operation, and which have occasioned, and are perpetuating, if not progressively increasing, those impediments to the navigation which are so justly complained of, it appears obvious to us that no partial measure can effect a general remedy, and improve the navigation of the river to that degree of which we feel satisfied it is susceptible. At the same time, we are of opinion that much good may be done by the adoption of certain remedial measures, which we shall presently notice: but we beg to premise that, in the adoption of those measures which we have in view, we contemplate their forming a part of an ultimate and general plan for the effectual improvement of the river, to which, as far as possible, they must be rendered conducive.

It may be here necessary to notice the ultimate plan to which we have alluded.

We have carefully examined Mr. Rennie's survey of the river in 1816, and, on the whole, we think his quay-lines judiciously laid down, and not requiring any material alteration in that part of the river to which our attention has been directed.

With respect to the section or water-way of the river, we approve generally of the limits assigned to it by Mr. Rennie.

In examining the various shoals and sand-beds in our progress down the river, the causes of their formation appeared to us to be the unequal and too great breadth of the river, together with the diminution in the velocity of the current, and the eddies produced by the tortuous direction and irregular form of its banks. The injurious effects of those causes are rendered most conspicuous by the sand-banks thrown up between Wincombe-lee and Hay-hole; and by the Bill Point, the St. Anthony's Point, and the Friar's Goose Point.

The first material shoal, in passing down the river, is at Tyne Main. This nuisance may be immediately abated by dredging, and ultimately removed by building a quay from Tyne Main Staith to the Friar's Goose quay.

The next material objects which struck our attention were the quay at Friar's Goose, and the sand-bank in front of St. Peter's Quay. The salient angle of this quay ought to be rounded with a gentle sweep, and the quay-wall continued up the shore to Tyne Main Spout. These operations would straighten the channel, and abate the sand-bank on the opposite side, by the scouring effect of both the flood and ebb tide.

The Ellison's Main shoal and the sand at St. Anthony's Point are the next important obstacles; the best mode of dealing with them is to continue the quay westward on the south side of the river, at Snowden's Hole, as nearly upon Mr. Rennie's line as may be practicable, and to employ the dredging machine. We think that it would also be of great advantage to have a quay built on the north side of the river, from Hoyle's cinder ovens to Stephenson's building-yard—to accomplish which, we advise every encouragement to be given to private individuals.

The Bill Point, with its shoals above and below, next attracted our attention. The sharp rocky angle of the point presents a formidable obstacle to the navigation of this part of the river, not only by the sudden turn it causes, but also from the depositions of sand which are formed both above and below the point, by the eddy it causes in the flood, as well as during the ebb tide. We are so satisfied of the great injury which this projecting rock occasions to the general navigation of the river, and the obstruction which it presents to the flowing of the tide, that we earnestly recommend its abatement to the extent of fifteen feet, at least, for the present,—and by cutting it down for four feet below low-water mark. We are the more inclined to urge this measure, as we have reason to think it might be accomplished at a comparatively small expense, particularly if the rock to be removed could be converted into quay stones.

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Below the point, as far as the east end of Walker Quay, the only defect of the river is, that it is too wide, thereby rendering both the flood and ebb tide too sluggish to clear it of the sand and silt which are there deposited, from time to time, as the causes which produce that effect operate. The only remedy for this is, contracting the channel to a proper size by quaying both sides of the river. But as it would require a considerable length of time to accomplish this, we recommend the quay on the south side to be first commenced, to extend from Bootland's yard to Moody's quay, and from thence to the west end of Hebburn Quay.

From the east end of Walker Quay, and the west end of Hebburn Quay, all the way down to Hay-hole, the injurious effects resulting from the inordinate width of the river, and other causes, are still more obvious—particularly between the Cook-crow, and Walker, Gosforth, Heaton, Wallsend and Killingworth staiths, on the opposite side. Nothing but a commensurate diminution in the breadth of the bed of the river here can remove those extensive sand banks which impede the navigation; but as this extensive operation would require much time and a large sum of money to complete it, we advise the partial measures of deepening the shoal parts of the low water channel, by dredging, from the high end of Hebburn Quay, running obliquely across the river to the eastward of Cuxledge Spout, and thence sweeping down the north side of the river, by Walker, Gosforth, Heaton, and Wallsend spouts to Killingworth spouts; and then running obliquely across the river again, in a south-east direction, by Hebburn and Springwell spouts. This, we feel persuaded, will produce considerable and immediate benefit; and, at the same time, we recommend a quay to be built on the the south side of the river, from Hebburn Quay by the Black Staith to Jarrow Quay; this quay to be built on Mr. Rennie's line. We of course consider the building of this quay to be a work of time, and to be proceeded with gradually. But we recommend the dredging of the shoal parts of the channel, as a measure for affording immediate relief.

The same partial plan which we have recommended for this portion of the river is applicable to the remaining part of the low water channel, from Jarrow Quay to Hay-hole; that is to say, by dredging alone, as the quaying of this part, involves the great question of quaying off Jarrow Slake, a project which does not seem to be embraced in our instructions.

The first steps to be taken to carry these suggestions into effect, are to cut off the salient angle of Bill Point, as recommended, and to procure a powerful dredging machine,—as we are of opinion that the immediate application of an *efficient* dredging machine to the partial removal of those sands, which chiefly obstruct the low water channel, would be the readiest mode of removing the most material impediments to the navigation.

Looking forward to the ultimate completion of the general plan of improvements already alluded to, we recommend, that in all those parts of the river where quays may be required, they should, as far as is advisable, be projected upon Mr. Rennie's lines; and the more easily to accomplish this, we recommend that the several land owners on those parts of the river should have every reasonable inducement and facility afforded for undertaking the building of such quays themselves.

There is another sand of less moment than the others, but occurring at the very outset of our passage down the river, which we have deferred noticing until the last. The sand we allude to is that which lies out from the south shore, opposite to and extending above the mouth of the Ouse Burn, and also on part of the north shore. This sand might be almost entirely, if not wholly, removed by the elongation of the quay on Mr. Rennie's line, from the Folly Wharf to the Ouse Burn, which would afford ample accommodation for the increasing commerce of the town.

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River Jury's Opinion on Sub-Committee's Report.

Opinion of the River Jury on the Remedial Measures recommended by the River Improvement Sub-Committee, appointed by the Corporation and the Chamber of Commerce.

25*th September*, 1834.

We, the jury, sworn to present all nuisances done in the port of Newcastle-upon-Tyne, between Sparhawk-in-the-sea, and Hedwin Streams, in the river Tyne, having been requested by Henry Bell, Esquire, Mayor of Newcastle-upon-Tyne, to give our opinion upon the several remedial measures recommended in a report which has been made by the River Improvement Sub-Committee, appointed by the Common Council and the Chamber of Commerce, in compliance with such request beg leave to state that we have given such report our most attentive consideration, and have carefully perused the report of the late Mr. Rennie, and examined his survey of the river Tyne, which was taken in the year 1816, and also examined Peter Knowles, William Orrick, and William Harrison, three river pilots, who were recommended to us by Mr. Thomas Smith, the master of the pilots at Newcastle, as men of great experience; and after due deliberation, we submit to the Common Council the following, as our opinion on the report of the Sub-Committee.

From the experience of many of us, and from the evidence of other persons, we are of opinion, that the channels of the river are now as good as they have been within the memory of any man living; but at the same time we must admit that the river is capable of great improvements.

With respect to the late Mr. Rennie's survey of the river in 1816, alluded to by the Sub-Committee, we think that the adoption of the whole of it might possibly have the effect of lessening the depth of water on Tynemouth Bar, which would more than counterbalance any benefit which might arise. And in his report Mr. Rennie appears to have entertained an apprehension that such effect might result. We, therefore, recommend the Common Council to take the opinion of an eminent engineer before they decide on its execution.

Amongst the remedial measures recommended by the Sub-Committee, that of employing efficient dredging machines meets with our cordial approbation; and we cannot too strongly recommend the immediate adoption of them, being satisfied that the machine which has been applied (though a very inefficient one) has done much good.

We beg to call to the recollection of the Common Council, that as far back as the third of April last, we strongly recommended to them that they should use their utmost endeavours to induce the owners of the shore from Tyne Main Staith down to the west end of the quay at Friar's Goose, to build a quay down the whole length of that shore, for the purpose of preventing the earth and soil from falling down from the bank above into the river. As to the recommendation of the Sub-Committee, that the salient angle of Friar's Goose Quay should be removed to the extent of 12 feet, we are of opinion, that it would not be expedient to do so, as we cannot see what benefit the river could

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derive from its removal; on the contrary, we apprehend that it might have the effect of lessening the depth of water at Dent's Hole, which is a safe place for laden ships of great burthen to lie in.

We agree with the Sub-Committee that the river would be improved by the building of a quay at Snowdon's Hole, as near as possible on Mr. Rennie's line.

We consider that if a quay was built from Hoyle's cinder ovens down as far as Stephenson's ship-building yard, on the north side of the river, it would abate a great nuisance by preventing the earth, soil, and rubbish, from falling into the river from the banks there.

As to Bill Point, we agree with the Sub-Committee that the navigation of the river would be greatly improved by its removal, but instead of taking from it 15 feet, we recommend that it should be removed to the full extent of 30 feet; and that the rock to that extent should be removed down to the bed of the river, and not to the extent of only 4 feet below the low water mark.

With respect to the recommendation of the Sub-Committee, that a quay should be built from the east end of Bill Quay down to the west end of Moody's Quay, on the south side of the river, we consider it a duty which we owe to ourselves to state to the Common Council, that upon a petition which was presented to that body by Mr. William Boutland, a shipbuilder, for a licence to build a quay down that very line of shore, we gave as our opinion that the navigation of the river would not be injured by the building of such quay, in the line laid down on a plan which accompanied his petition, provided the shelving rocks, which lie under water in the front of that shore in several parts, were removed, so as to allow ships to come close up to the face of the intended quay. And we beg to state, that the building a quay along the whole length of the shore in question would, in addition to the convenience which would be thereby afforded to trade and commerce, abate a great nuisance, by preventing the earth, soil, stones, and rubbish from falling into the river from the rocky banks above the shore. and also by preventing ships from getting upon the shelving rocks before mentioned; and we consider that the facilities to trade and commerce, which such a quay will afford, and the nuisances which will be abated, will more than compensate for the quantity of tide water which will be displaced.

We now come to the recommendation of the Sub-Committee of an elongation of the public quay at Newcastle, and we beg to state that that subject has not entirely escaped the officers of the corporation; for as far back as the 17th of January last, Mr. Jonathan Cram, the quay-master, recommended that this quay should be extended downwards as far as the Swerle. Mr. Cram's recommendation, as far as it goes, would certainly give a considerable extension of quay; but we think, with the Sub-Committee, that it would be much better to extend it as far down as the mouth of the Ouseburn. Whether it should be built upon the line laid down by Mr. Rennie, we will not take upon us to give an opinion; and we recommend that if such quay should be built, the corporation should consult an engineer, sufficiently experienced in river navigation, whether it ought to be built as far into the river as Mr. Rennie's quay line extends.

I am, &c.,
JONATHAN CRAM, *Foreman.*

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No. 191.

Observations on the Influence of Jarrow Slake on the Tides in the Tyne. *By* JOHN MACGREGOR, Esq., Surgeon, Royal Artillery.

GENTLEMEN,

5th January, 1836.

A few years ago I happened to engage in an investigation respecting the navigable state of the Tyne, which had long excited very general dissatisfaction. I did so, because I believed such an inquiry would prove acceptable—perhaps beneficial, to the interests of the port.

I published my observations in 1832; since which time they have slept, but the appointment of new conservators having revived the hope that attention will at length be gained to this interesting subject, I again cheerfully renew my labours for the public good.

In addressing you on the present occasion, I have selected only one head of the plan of improvement for your consideration, namely, the question respecting the propriety of inclosing Jarrow Slake, and I have chosen it not only as a fit medium for resuscitating the general subject, but also because its importance renders a final decision regarding it highly necessary. Bordering upon the river, its convenient situation, large extent, and level surface, render it most eligible and desirable for every species of trade and manufactures, and for the accommodation of shipping. It seems, indeed, as if the mercantile capitalists only awaited the release of this valuable space from the dominion of ancient prejudice to avail themselves of it for such purposes. Nor, in our estimate of public advantage ought we in justice to overlook the consideration due to the owners of the soil, who would reap a large amount of income by so wholesome an appropriation. To all these interests the inclosure of the Slake would be clearly beneficial; our next step, therefore, is to endeavour to ascertain whether it would be so to the navigation, for, if this can be made out, its alienation from the river will, I presume, immediately follow. I am aware that even among eminent engineers of the present day, opinions are various and contradictory respecting the utility of such inlets as Jarrow Slake, some recommending to preserve these receptacles to their full extent, while others contend that they are highly detrimental. I have not met with any work or professional report in which this particular subject has been argued; I have read nothing but appeals to the ruinous consequences of one practice or the other. It appears to me that this discrepance of opinion has arisen from including in the same category the cases of estuaries, harbours on the coast, and inlets within rivers, which are all essentially different, and require specific modifications of treatment. Where this is not attended to, the practice may be injurious, and the principles themselves impugned, while the error is due only to their misapplication.

In treating this subject, I shall first examine the value of the several objections to the inclosure of the Slake, and afterwards briefly point out what I believe will be the real consequences of such a measure.

The first, and by far the most important objection, is founded upon a popular opinion which has obtained from time immemorial, that this slake causes more tide-water to enter the river than the sea would supply without it at such periods. This opinion has arisen, in all probability, from a misconception that the greater the space which a tide has to spread over within a river, the greater will be the velocity of the tide up the channel, and, consequently, the quantity furnished by the sea during the time of flood. Such persons speak of Jarrow Slake as drawing in the tide-waters; hence their

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common term in-draught, which, originating in times of ignorance, has hitherto greatly perplexed the subject by obscuring the true action of the tides in rivers, and the natural effects of dilatations in the channel.

In endeavouring to remove this misconception we must, in the first place, attend to the circumstances which promote and retard the flow of a fresh-water stream. The first are, the slope of the surface, the volume or depth, and contraction of the channel. In corroboration I quote the following principles :—

1st. "An open stream derives its motion entirely from the slope of its surface, and the modifications of this motion, or its velocity, from the width and depth of the stream."*

2d. "When a stream has its section diminished by narrowing the channel, the current increases in depth, and this is always accompanied by an increase of velocity through the whole section, and most of all at the surface, and the area of the section diminishes."†

3d. "Deep waters have an energy, when in motion, not to be found in shallow running waters, by which they are enabled to continue that motion; but this is not a moving principle: it is an energy common to all great bodies."‡

4th. "The weight of water contributes greatly to its motion, so that it is not in proportion to the slope only."§

5th. "When the sections of a river vary, the quantity of water remaining the same, the mean velocities are inversely as the areas of the sections. This must happen in order to preserve the same quantity of discharge. ||

I may here add that Zendrini, in his experiments with the pendulum, discovered that the velocities, in the different parts of a section in the river Po, were nearly proportional to the square roots of the heights, when the velocities were not very great; and that it has been found, that in a parabola, of which the abscisses represent the depth of a river, and a corresponding semi-ordinate represents the velocity, all the other semi-ordinates will express velocities corresponding with the heights of their respective abscisses.¶

The chief retarding causes are, friction, impact, eddies, and dilatations of the channel, or enlargement of its sections. In regard to the latter cause, we have already seen that the velocity of a stream is diminished in proportion to the enlargement of its bed; and, without authority, we learn, from common observation, that when a swollen river overflows its banks, from that moment its velocity is checked. If we kept this simple principle in view when we contemplate an upward flow, we could not fail to perceive that the same result must follow in both cases, unless we dispute the axiom that the same causes produce the same effects under similar circumstances. In short, all the conditions which modify the descending stream must, from the nature of fluids, modify in the same manner, and *cæteris paribus*, in the same degree, the upward current. It is true there are more impediments to the latter, but this does not alter the nature and operation of those modifying influences which remain common to both.

We have now, in the second place, to inquire into the cause of the tide's ascension in a river, and whether it depends upon one or more causes. The tide in rivers, as is now well known, is merely the propagation of the great tide-wave in the ocean, which has been raised chiefly by the attraction of the moon; when it comes to the mouth of a river, being confined within narrow bounds, it rises and is urged on by the force behind which brought it to our shores. When arrived at the mouth of a river it checks the current of its waters, and they accumulate there. This checks the current further up, and they accumulate there also; and this check of the stream, and consequent rising of the waters, is gradually communicated up the river to a greater or less distance. In this point of view, therefore, the tide in a river is produced solely by the force of the oceanic tide-wave. An eminent philosopher of the present day thus further describes the theory of its action:—"When the tide-undulation reaches the mouth of a river, the line of the wave is observed to revolve round the promontory which it first reaches of the two, which form the opening of the river, and in this way soon meets the opposite promontory. After this, it assumes a direction at right angles to the course of the river, and advances regularly up the stream. Here, then, is a point of convergence of the tide-wave, and the magnitude of the tides will be in proportion to this convergence or swelling of the wave. The augmentation may amount to something considerable, as in the case of the tides in the Wye, at Chepstow, which rise 60 feet. If we consider these very high tides of convergence as a mechanical question, they may be accounted for by what is called 'the principle of the conservation of force.' When any quantity of matter is in motion, its motion is capable of carrying every particle of the mass to the height from which it would have to acquire its velocity; but if the motion be employed in raising a smaller quantity of matter, it is capable of raising it to a height proportionally greater. In bays and channels, which narrow considerably, the quantity of water raised in the narrow part is less than in the wider, and thus the rise in such cases is greater. As the wave advances up the river, its height is gradually diminished by various causes which absorb its force. The great tide in the Wye is, in this way, extinguished before it reaches Tintern. It will be easily conceived, therefore, that a small tide would travel a shorter distance than a large one before its extinction, and that a rise of tide, which occurs in the lower part of a river, must have a certain magnitude, in order that it may affect a point in the upper part at all; and the affect on this upper point will be only that which arises from the excess of the tide at the lower point above the amount which is just perceptible above."** Now, in all that has just been stated, there is no allusion to any advenient aid to the tide within a river, its progress from beginning to end being considered due to its own inherent power. We are told that it is urged on by the power behind; that the magnitude of the tides is in proportion to the swelling of the wave at the point of convergence; that high tides are accounted for "on the principle of the conservation of force;" that as the wave advances up the river, its height is gradually diminished "by various causes which absorb its force;" and that "a small tide travels a shorter distance than a large one before its extinction;" thus plainly intimating that it is the external force alone which propels the tide into a river, and causes it to ascend in spite of the slope, the current of fresh water, friction, impact, dilatations, and eddies, which obstruct its progress at every step, and, finally, exhaust and destroy it. In short, every terrene influence, however it may modify, will be found ultimately unfavourable to the progress of the tide-wave, both in the ocean and in rivers. It is true that variations of section occur in both these

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* Encyclop. Britan. vol. xviii., page 46. † Ibid. page 47. ‡ Ibid. page 54.

§ Buffon's Nat. History, vol. i. art. 10, English edition. || Playfair's Outlines of Nat. Phil., vol. i., page 197.

¶ Report on the Progress and present State of our Knowledge of Hydraulics, &c., by George Rennie, Esq., in the Report of the Fourth Meeting of the British Association, 8vo., 1835.

** The Rev. Mr. Whewell on Cotidal Lines. Phil. Trans.

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situations, and a consequent corresponding variation of velocity, but these are local and partial interferences, and do not, in any instance, increase the initial energy of the tide-wave, but, on the contrary, are found to belong to the causes which are continually weakening its power. In the sea this is verified by observing the gradual abatement of the rate of the tide as it approaches its termination. The velocity of the tide-wave, in lat 60° south, is about 670 miles an hour. It travels from the south point of Ireland to the north point of Scotland in about eight hours This distance is about 7°, or about 160 miles an hour along shore. On the eastern coast the velocity is less. From Buchan-ness to Sunderland, three hours give about 60 miles an hour; from Scarborough to Cromer, also three hours about 35 miles an hour; from the North Foreland to London, in two hours, makes the speed about 30 miles an hour; from London to Richmond, in one hour and a quarter, gives us 12 miles in that part of the river. Many causes, no doubt, conspire to produce this successive abatement of rate, as shallowness, the uneven form of the bottom and shores, &c., but how many soever the obstacles may be, the great tide-wave appears to traverse the globe unaided by any power, save that which gave it origin—the attraction of the sun and moon. In the Thames, taking four distances from London Bridge upwards, we find the following rates, which are sufficiently accurate for our purpose:—

				H.	M.
From London Bridge to Putney,	distance	$7\frac{3}{8}$	miles	0	31
,, Putney to Kew,	,,	$5\frac{3}{4}$	,,	0	$17\frac{1}{2}$
,, Kew to Richmond	,,	3	,,	0	$22\frac{1}{2}$
,, Richmond to Teddington,	,,	$2\frac{3}{4}$	,,	1	$18\frac{3}{4}$

It is clearly seen here that the velocity of the wave diminishes as we ascend the river Indeed the conclusion seems reasonable and inevitable, that as the magnitude and power of the tide-wave which ascends a river depend upon the form and dimensions of the mouth, and as this power behind sustains the whole upward motion, no circumstance can add to this initial force which does not share in its formation, except meteorological causes; when this impulse subsides and departs, the whole phenomenon of a flood-tide decreases and vanishes.

Returning now to the consideration of expansion alone, if we are satisfied that this circumstance abates the velocity of a land torrent, agreeably to the axiom that the velocities are reciprocally proportional to the amplitude of the sections, we might here pause and require our opponents to prove how expansion produces a different effect upon a downward and an upward torrent? How the height and velocity are diminished in one case and not in the other? How, in short, the law of gravity changes its nature with the direction of the stream? Meantime I shall present, upon this point, the opinion of one of the ablest engineers of the last age. It is Mr. Smeaton who thus speaks:—"The tide is spent by many turns in a river, and in filling the loops, and is thereby prevented from rising so high perpendicular as where the course is straight, and with a more regular contraction. The tide passes by before the loops are filled."* This is enough to put an end to the notion that "the loops" have any accelerating effect upon a flood tide; for if they had, they would fill themselves before the tide passed away; and behind this declaration we may defend ourselves against a host of the brotherhood.

Further, as a land-stream is not affected by an enlargement in advance until it reaches it, so neither is the tide affected by Jarrow Slake in any way whatever until it arrives there, and the waters begin to diverge in that direction. But at the point of divergence there is a resolution of force into, as it were, two components, to which the antecedent force in Shields harbour may be considered the resultant or equivalent. Now, as each of the components must be less than the resultant, it is clear that there must be a diminution of the velocity at the point of divergence.

Again, as the rate at which the waters overspread the slake is at least three times slower than in the channel, this lesser rate cannot accelerate the greater, because it is impossible that a slow motion in advance can accelerate a swifter motion behind. The abatement of the velocity being chiefly in proportion to the quantity of water abstracted, it is very small in a short space of time, but it is gradually accumulating from its commencement until high water, when we find that about $\frac{1}{10}$ of the whole waters of a spring tide have been withdrawn, which is as completely lost to the district above as if it had fallen into the channel of the Wear.

Again, Jarrow Slake has an ascending slope from the margin of the river to the opposite side, where it is, for the greater part, about three feet higher than the river line. As water, therefore, cannot flow against a slope, save by a force behind, it is clearly this force which sends it into the slake, which has, therefore, no power of in-draught, but, on the contrary, opposes the progress of the tide by this additional obstacle of slope.

Again, the diminution of velocity at the slake must, to a certain extent, re-act upon the current below, whose uniformity of speed is thus deranged; the slower motion above will have a tendency to check the velocity below, which is further similarly affected by a degree of pressure from the waters on the slake. The minuteness of this united impression may render it insignificant, but the tendency is important, because some may imagine that this expansion gives relief to the stream through Shields harbour, whereas there is no relief, nor can there be, while the slope of the channel and of the slake are contrary to the current. Nor, if there were, would it assist the current, because an abatement of quantity is, proportionally, an abatement of force.

Again, dilatations produce eddies, and every eddy destroys a portion of the moving force of a river. Though this also may appear an insignificant effect, yet with practical men it forms an important item in the aggregate of retardations.

Again, if Jarrow Slake accelerated the tide below it, then Coble Dean, the off-set at Willington Gut, and every other off-set, ought to be proportional accelerators; but this would be to raise their character to that of generators of power and efficient agents in the prolongation of the tides, which "in our philosophy," is ascribed entirely to the external force.

Variations of width in a channel can do no more than partially modify the rate of the stream as it passed their several localities, agreeably to the first and fourth axioms stated above; for to enable the sides of a river to increase, or even to preserve and prolong, the initial force entire to any distance, independently of gravity, would require them to be endowed with the elasticity of animated tubes; hence we find that water will not run even on a level, and that with a slope of $\frac{1}{500000}$ it is barely perceptible on a perfectly smooth bottom.

In fine, whichever way we turn in the contemplation of this question, the truth of the proposition, that "width lessens depth, and this the force and velocity," meets us, and compels assent as an intuitive perception.

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* Reports, vol. i.

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Still, however, an accelerating influence is ascribed to Jarrow Slake as a matter of fact founded upon observation. In Mr. Rennie's Report on the Tyne, made in 1813, we meet with the following remark:—"The rate of the current is generally greatest when Jarrow Slake is just covered, which is a little before half flood. Vessels entering the harbour at this time frequently derive advantage from this great expanse; for if they enter with an adverse wind, the increase of current helps them over the bar, when otherwise they would not be able to enter the harbour at all. When the water is covering it, there is an increase of the velocity of nearly a quarter of a mile."

But this is a mere *petitio principii*, not an inductive conclusion; no relation is proved between the effect and the assumed cause, which, in a point so problematical, and important to the navigation, ought to have been distinctly shown, and the dependence of the one upon the other demonstrated. We can consider it, therefore, as nothing more than an unfortunate echo of the ancient popular misconception respecting the accelerating influence of this slake, which carries improbability on the face of it; because, to believe this, is to believe that a quantity of tide water, a few inches in depth, flowing over this expanse, can affect the motion of the tide in the sea for miles round the mouth of the river, and at the same time that it is flowing at a rate superior to that in the slake.

Here Mr. Rennie has evidently committed a great oversight, for, if a power of accelerating the tide, or *vis à fronte*, could be allowed to exist within the channel at all, then it ought to reside in the highest degree in the great mass of water moving in the channel with a rate superior to that over the slake. But this power is neglected, and the *vis à fronte* ascribed to the minute quantities of water successively and slowly overspreading the slake; which is to ascribe to a power whose value may be supposed 1, an effect which is denied to a similar and co-existent power whose value may be supposed 10,000—an *argumentum ad absurdum* so palpable as to suffice, with all justice to the subject, to release us instantly from any further notice of so puerile a conception.

That during spring tides there is an increase of rate at half tide is undoubtedly true, but it is an error to suppose Jarrow Slake the cause of this, because it has long been discovered that in the sea spring tides rise considerably higher than half the whole height in the first half of the time of flood. This impulse has also been discovered to be a property peculiar to the spring tide wave, which it carries with it into all our tide rivers. The following tables exhibit the rates at which a spring tide rises and falls throughout the whole period of a tide, both in the sea and in the Thames. At Plymouth the observed rates were as under:—

Flood. Hours.	Height. Ft.	In.	*Ebb.* Hours.	Height. Ft.	In.
1	1	6	1	1	6
2	2	6	2	2	6
3	4	0	3	4	0
4	4	0	4	4	0
5	2	6	5	2	6
6	1	6	6	1	6

At Plymouth it is stated the tide usually rises to 16 feet, and that this table will serve for other places where it may rise as many fathoms, or not so high, by proportional addition or subtraction. It is copied from the "Philosophical Transactions Abridged," vol. i., page 227. At page 291 of the same volume, another table is inserted, calculated for quarters of an hour, by Captain Sturmy, who mentions that his observations were made at Hoang Road, four miles from Bristol, and that this phenomenon occurs only during spring tides.

The following tables contain the result of similar observations on the gradation of the flowing and ebbing of a spring tide in the Thames, taken above and below the late London Bridge by Mr. Francis Giles, on the 29th July, 1821, being the day of the new moon.*

ABOVE BRIDGE.

Flood.

	Ft.	In.
Depth when flood began,	6	0
1st hour's rise	2	11
2nd ditto	3	0
3rd ditto	2	10
4th ditto	2	8
45 minutes	1	0
4 hours 45 minutes	18	5

Ebb.

	Ft.	In
1st hour's fall	2	1
2nd ditto	2	7
3rd ditto	2	0
4th ditto	1	9
5th ditto	1	5
6th ditto	1	2
7th ditto	1	0
55 minutes	0	11
Depth at low water	5	6
7 hours and 55 minutes	18	5

BELOW BRIDGE.

Flood.

	Ft.	In.
Depth at low water	1	3
1st hour's rise	5	9
2nd ditto	5	4
3rd ditto	2	9
4th ditto	2	5
48 minutes	1	4
4 hours 48 minutes	18	10

Ebb.

	Ft.	In.
1st hour's fall	2	1
2nd ditto	4	4
3rd ditto	3	1
4th ditto	2	7
5th ditto	2	3
6th ditto	1	9
7th ditto	1	6
59 minutes	0	11
Depth left	0	4
7 hours 59 minutes	18	10

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* Mr. George Rennie's Report, cited above. Also the Edinb. New Phil. Journal, Art. 5, 1826–7.

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The above observations show the universality of this phenomenon, and that it is a peculiar property of the spring tide wave, generated in the ocean, and carried with it into all our tide rivers. As I have not met with any explanation of its cause, it probably belongs to those inexplicable anomalies which still adhere to the theory of the tides. We have thus discovered a general and adequate cause for the increased rate of the tide at half flood in the Tyne, and to impute it to any other, more especially to that assigned in Mr. Rennie's report, is both unreasonable and unphilosophical; and the more so when we further consider that if the flow upon the slake produced this effect, it ought to continue it during the subsequent period of the flood; but we have just seen that the reverse takes place. Again, if the slake were the cause of this phenomenon, it ought to occur in neap tides, when the slake is also covered to some depth, but Captain Sturmy has informed us that it is confined to spring tides.

Thus we get entirely rid of the assertion, that Jarrow Slake possesses a power of in-draught, as a fact founded upon observation, which, if it could have been sustained, would have triumphantly refuted all reasoning to the contrary.

So far then, as we have yet pursued the subject, it appears that this expanse does not increase the velocity, but decreases it by invading the mechanical principle of the conservation of force.

But this is not all, for it likewise diminishes the momentum or moving force of a tide, so necessary to enable it to contend against the current of fresh water, the slope, and other impediments to its progress.

In the beginning of this paper, it was noticed as a principle, that "the weight of water contributes greatly to its motion," a principle which applies equally in all cases. It is indeed the chief element of the motion of water, and is eminently necessary to the existence and prolongation of a flood tide.

The momentum, or quantity of force in a moving body, is compounded of the velocity and the mass or weight of thebody, and is as the squares of these quantities singly; if either be doubled the momentum will be quadrupled, but if both be doubled, it will be raised to the 16th power. On this point, Mr. Smeaton observes, "The force of water in scouring away a sand bank, or deepening a channel, is always proportionate to the quantity acting in a given time, and the vigour or force with which every equal part of the quantity does act. Thus, for instance, if a ton of water was to pass over a sand in a minute's time, and every gallon of that water exercised a force on that sand, which may be represented by unity, then the whole force exercised in a minute's time on that sand may be expressed by the number 250. But if the quantity acting in the same time be doubled, and the force with which every gallon acts be doubled also, as it will if the velocity of the current be doubled, then the force in a minute's time will be four-fold what it was before." Here, however, Mr. Smeaton makes the new power too small, for, since it is as the square both of the velocity and quantity, the expression becomes $2+2\times4=16$.

It might be difficult to assign the value of the decrement of momentum corresponding to the infinitesimal decrements of velocity and weight, but as that of the latter becomes gradually more tangible, we soon acquire, in respect of it, a ratio which will enable us to perceive the effect distinctly enough for our purpose.

Mr. Rennie states, that during a spring tide, on the 31st of May, 1813, 726,621,000 cubic feet of water entered the river. This is about 20,760,600 tons. Now, as the area of the slake is 338 acres, and as I found from rude measurements the average depth of an average spring tide to be five feet, we find that the slake abstracts about 2,000,000 of tons during the two hours and a half in which a spring tide is filling it. If we then suppose the tide to rise equally during this time, we shall find that above 400,000 tons are abstracted from the channel every half hour, the square of which will give the proportional loss of momentum which the tide experiences every half hour above this locality, in consequence of the loss of this quantity of water only.

The efficacy of momentum in augmenting the height of a tide by ponding back the fresh water is considerable. When not affected by the tide the surface of the water slopes, but when the tide begins it raises the surface of the lower part of the river, so as to diminish the slope of that part; that this altered surface extends successively higher and higher up the river, and is nearly horizontal at high water; after that, the tide surface again descends, and the effects of it disappear in succession from the parts of the river, beginning with the upper parts, till the low water surface is again attained. Now, the degree of depth produced by these means depends greatly upon the volume of the tide opposed to the fresh water; hence there may be a tide in a river without any up-current at all, and a powerful impulse will prolong a tide far beyond the limit to which the sea-water extends.

But the diffusion of two millions of tons of water in the upper part of the channel must, from its bulk alone, increase the height of tide there. I am aware, that in the case of a descending stream, the addition of a much larger quantity would produce only an increase of velocity, owing to the operation of gravity; for, according to Professor Playfair, a river whose breadth is 10 feet, and depth 1, requires the addition of another of equal dimensions to raise the height to 1·4332, and the original velocity from 37 to 50 nearly.*

The experiments of Genneté, made at Leyden, in 1755, give a different result, and are much less favourable to the increase of the height by even more considerable augmentations of volume.† But in the case of an upward flood acting against gravity, and constantly resisted by the fresh-water, we find that the ratio of the height increases while that of the velocity decreases until high water, when the one attains its maximum and the other its minimum.

The loss, then, of the assistance of 400,000 tons of water every half hour, in producing depth, by ponding, and by adding thus much to the general mass above, cannot fail to be viewed as an important deterioration of the navigable state of the river.

This quantity would fill a branch from the river two miles long, and a quarter of a mile broad, to the depth of five feet; and, if the slake were 10 feet deeper, it would abstract a quantity that would fill a branch six miles long and of equal breadth to the same depth, which would probably diminish the height of a spring-tide, at Newcastle, more than one-third.

We have a notable example before us of the injury which the navigation sustains by the division of a stream. The river Derwent, which passes Derby, was made navigable in the beginning of the last century; but since the formation of branch canals to the Erewash and Trent, the navigation of the river has ceased. These branches are each eight and a half miles long, but the amount of water which they withdraw I am unable, at present, to state. But it seems evident, that if they were shut up, and the old channel cleansed, the navigation would be restored. So, if Jarrow-slake withdrew six millions of tons from the Tyne, and thereby diminished spring-tides one-third at Newcastle, would the

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* Outlines of Nat. Philos., vol. i., page 196

† Mr. George Rennie's Report, as above.

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former depth there be recovered by enclosing it? If, therefore, it would be beneficial to shut out a great expanse, it must, upon the same principle, be proportionally advantageous to shut out a small expanse, and thus preserve the velocity, momentum, and depth, to their full extent. As we have shown that the slake does not increase the velocity of a tide between it and the sea, and as we know that only a certain amount of water enters the river during a certain time, it is clear that if any portion of this be diverted from the channel at the slake, less will remain to pass upwards.

But Jarrow Slake is further injurious to the river by diminishing the scouring power of the ebb tides, which is manifestly too feeble at present.

On this point Mr. Smeaton observes, "The removal of a sand-bank must be effected by the ebbs and back-waters, which should be conveyed as entirely, unitedly, and directly to it as possible, so that they may exert their whole undiminished force and power thereon, without meeting with any stops or impediments in their way. For the force of water in scouring away a sand-bank, or deepening a channel, is always proportionate to the quantity acting in a given time, and the vigour or force with which every equal quantity does act." To the same purpose Guglielmini observes, "The waters of the sea, which, during a flood, enter into the beds of rivers, returning back with the ebb, help to clear out the bed, and to sweep away the deposits."

Thus it appears that Jarrow Slake decreases both the velocity and momentum in the contiguous portion of the channel, and the depth and scouring power of the ebb tides in the parts above; all which consequences result from the infringement of the principle of the conservation of force. It is for the same reason that I have elsewhere recommended the exclusion of Coble Dean from the river and the contraction of the Long-reach.

We now come to a brief consideration of another objection to the enclosure of the slake, namely, that during a great fresh it takes in so much water as reduces the height of an inundation in Shields harbour, and thus eases the current there in such seasons. The great flood of 1771 rose at Newcastle 7 feet 4 inches above the height of a spring tide. "The utility," says Brand, "of Jarrow Slake appeared in this disaster, as it took in so immense a body of water, that at Shields the flood was no higher than a spring tide."

Here we may remark an easy and natural acquiescence in the proper effect of expansion in regard to a downward stream, while, as stated in the outset of this paper, the same consequence was denied to result from the same cause, in the case of an upward current—at least by popular opinion. If a knowledge of the laws which govern the motion of streams be necessary to discover this unity of effect, then we can readily excuse those who had not the means to make a discovery to which analogy alone seems sufficient, the parallelism being self-evident.

It is undoubtedly true, that while the slake is filling from a land-flood, both the velocity and the quantity which would otherwise pass to the sea with the main stream will be somewhat abated, just as happens in the case of a spring-tide, but infinitely less in degree, and by no means to the extent represented by Mr. Brand, which is the error upon which we at present animadvert. To show this in a plain manner, we have only to consider, that the slake, being a *cul de sac*, can receive but a limited quantity of the land-flood, and no more than is sufficient to fill it to the height of the waters in the channel, which, if they surpass a little the height of a spring-tide, may send into the slake somewhat more than two millions of tons. Now, taking the width of the channel here at one-third of a mile in such seasons, the average depth at 15 feet, and the rate at seven miles an hour, as in the flood of 1831, we shall find that about 27,878,396 tons pass by this slake in an hour; and if the flood should continue at its acmé for 12 hours, there will, in this space of time, escape into the sea 334,540,752 tons, while Jarrow Slake has abstracted, at most, 2½ million tons. I do not profess to have given exact calculations of the relative quantities, this being unnecessary where their difference is so immense, and where the tendency one way or other is all that is sought. But rude as those approximations are, they will, I hope, be sufficient to convince us of the utter insignificance of this slake to the safety of Shields at such seasons.

That land-floods have their height reduced as they approach near to the sea is a fact which has long been known; but it is likewise an error to assign Jarrow Slake as the cause of this, as may be inferred from what has just been stated. But it was the philosophical acumen of Major Rennel, which revealed the cause and removed all doubt respecting it. In his "Geography of Herodotus," he informs us, that, "all such inlets situated near the borders of the ocean cannot, during the time of a land-flood, be it ever so great, receive more than they do during a spring-tide, nor so much, if it coincides with the period of a neap, because the ocean influences the level of all waters that communicate, with it, except such as cataracts." In speaking of the Nile, in the same work, he further explains this phenomenon. "For, although the river," he says, "may swell 30 or more feet, with the periodical season, in parts removed from the sea, yet, at the point of its junction with the sea, it cannot rise at all, since water cannot be retained in a heap, but must form a common level with the mass with which it mixes. The land-flood, therefore, will form a slope of such a nature, as its gravity combined with the declivity of the stream will admit."

This fully explains the cause why the flood in the Tyne, of 1771, rose no higher than a spring-tide in Shields harbour. It shows, also, that the ocean is the sole controller of the height of land-floods near the mouths of rivers, and that the agency of Jarrow Slake, in producing this effect in the Tyne, is as imaginary as that of its accelerating a tide from the sea.

There remains but one other objection to dispose of, which is, that the slake serves as a reservoir of tide water by which the ebb is prolonged, and a convenience thereby afforded to the shipping in Shields harbour. But this, at first sight, is impossible, because its waters move off as they come on, in conjunction with those of the main stream, and the slake is empty before half ebb; and because the gradual addition of its waters to the ebb current must accelerate rather than retard its motion. No partial enclosure could form it into a resevoir for subsequent use, or in any way improve its power, and I presume no one would venture to propose the expensive construction of a wall with flood-gates, in the hope of thus scouring Shields harbour, which it would not do generally nor usefully, experience having shown that the effect of a large dam, when its waters are let loose, is to tear up the bed of a river, ploughing it into deep furrows with ridges of sand and earth on each side. Commotion, and great derangement of the bottom of the harbour, would be the only consequences of such a measure, which must necessarily impair, perhaps destroy, the navigation. As to the shipping, such a back-water would be of little use to them, since it would not add an inch to the depth on the bar, because it could not raise the level of the sea. Large vessels, therefore, would be still obliged to remain in the harbour until the tide did this for them. It would be useless to pursue this chimæra farther.

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In conclusion, we have to remark, that the enclosure of the slake could not possibly prevent the whole waters of a tide from ascending beyond it In the first place, the friction along the side of the enclosing wall or quay would be less than upon the bottom of the slake by more than one-half In the second place, as the whole amount of a tide would then, as now, be propelled into Shields harbour, the almost infinitesimal portions which are now successively deflected into the slake at every moment of the rise must, from the cohesion of water, adhere to the great mass in the channel, and thus be borne along with it, and accumulated above instead of in the slake. This must happen, because they form integral portions of a moving mass of water, all the parts of which must move together in the same direction in a free channel.

This salutary consequence appears to be the only one which can possibly result from the enclosure of the slake. Throughout I have felt the importance of this great and long agitated question, and have, accordingly, given it my best attention; but in all the aspects in which the subject has presented itself to my mind, I have not found a single sound argument in defence of the alleged propriety of keeping open this slake; but, on the contrary, many substantial reasons why it should be enclosed—above all, the improvement of the navigation.

No. 192.
Cubitt's Report on the River Tyne Navigation.

No. 192.

Mr. CUBITT's *Report on the River Tyne Navigation.*

GENTLEMEN, *London*, 24*th June*, 1837.

Adverting to my visit to Newcastle, in the month of March last, for the purpose of inspecting the river, and examining the state of the navigation and the plans proposed for its improvement; and with reference to Mr. Clayton's communication of the 31st of that month, requesting me to make an early report, and to estimate the comparative expense of constructing the new quays, with 6, 8, and 10 feet depth in front thereof at low water respectively; I have now the honour to submit the following on the subject for the consideration of the Committee.

Without going at all into a history of the past and present state of this river, or a long detail of causes and effects which influence and succeed each other in producing certain bends, shoals, channels, &c., all which have been ably commented upon by the late Mr. Rennie and others, I shall take up at once the excellent survey of the river as made by Mr. Giles, under Mr. Rennie's directions, and admit that the general lines of the shores as laid down upon that plan are for the most part good, and that the Committee are acting judiciously in deciding to have them carried into effect, with such modifications as the peculiar circumstances attending the trade of the river Tyne may appear to require.

Leaving alone for the present the question as to the Jarrow Slake, and the erection of a pier or breakwater at the entrance of the harbour at Shields, I shall confine myself more immediately to the important questions of the new quays, and the improvement of the river channel; and

1st. *Of the New Quays.*

The line of the new quays from just below Newcastle bridge, to the "Ouseburn," I esteem to be very well laid down upon the enlarged plan sent me; although probably some little improvement might be made at the town end by continuing the straight line quite up to Newcastle bridge, eventually even at the sacrifice of a few feet of quay room there, and even of the first small archway of the bridge; for as the piece of present quay which would be left next to the bridge must be underpinned, it will be but little more expense to rebuild it entirely, after a sufficient portion of the new quay be completed for the purposes of business.

In order to make this matter quite clear, I have made a copy of the enlarged plan, and drawn such a line as I recommend to be executed. I have also made some cross sections of the kind of quay wall, such as in my judgment is suitable for the situation, and showing 6, 8, and 10 feet in front at low water respectively.

These quay walls I propose to be 6 feet in thickness, with counterforts every 18 feet; the face of the wall to be a curved batter of 100 feet radius, the centre level with the top of the wall.

I would also suggest that the work should be commenced at the point where the proposed line of new quay intersects the present quays, and to be carried on in 100 feet lengths by means of coffer dams: by which arrangement, the berthage of only one length of vessels would be interfered with, till such time as the present quays be passed, when the dams may be extended to such length as may be deemed expedient. After a sufficient length of quay is built downwards to become useful for bs, and before the river in front be dredged out and deepened, it will be adviseable either to underpin in its present shape, or to take down and rebuild in its new line, that portion of the old quay between the new work and the bridge; after which, the whole may be deepened to such extent at low water, as may be suitable to the depth at which the quays may be founded.

In order to obviate the very great expense of constructing quays with great depth in front at low water by means of coffer dams, and also to avoid the interference with the business which they would occasion, I have endeavoured to devise a mode of effecting the desired object without coffer dams, by driving a close wharf of cast iron piles, reaching above low water, and surmounting the same with a stone quay and fender piles, which would be the same in appearance and utility as an entire stone quay from the bottom, and could be carried on in its construction in several places at the same time, each taking up no more space than just what is occupied by the piling engines, &c.; it has also the merit of being less expensive; and from the experience I myself have had with cast iron piling, and from the very successful manner in which the same principle of constructing large wharfs has been carried into effect in the river Thames, by Mr. J. Walker, Mr. Selby, and others, I have no hesitation in recommending this mode of construction, should the principle of entire stone wharfs be deemed too expensive.

Plans and sections of the stone wharfs, with 6, 8, and 10 feet depth in front at low water, and also of iron wharfs with a stone superstructure, will be found in the drawings which accompany this report.

There is no branch of practical engineering so expensive or more subject to contingencies, than that of founding large quay walls in a tideway with a considerable depth at low water. A few feet more or less in the depth makes but little difference in the gross expense, the dams and preparations being alike for each; nor is there any economy in the long run in doing works of this kind in an insufficient manner. If there were, money might be saved in building the quay walls upon the shore at low water, and leave the deepening of the river in front out of the question. But this would only entail additional expense at some future period, whenever the foundations required to be renewed, or the water in front of the quays deepened, as is the case at present with those just below Newcastle bridge.

On the whole, my opinion with regard to the new quays is, that they may be constructed upon various plans, and with different degrees of accommodation with regard to depth in front at low water, but that taking the minimum depth at 6 feet, and the maximum at 10, the cost of the cheapest efficient mode of construction without coffer dams, and with 6 feet in front at low water, will not be less than £15 on the average for every foot run of quay wall; and that to build entire stone quays from the bottom, with 10 feet depth at low water in front, will cost on the average £25 per foot run; and that from £15 to £25 per foot run, according to the depth of water and mode of construction, will be the cost of good quays; which will make the whole expense of renewing the quay from "Newcastle bridge" to "Ouseburn," amount to a sum varying from £60,000 to £100,000, taking the entire length of new quay to be 4000 feet.

Compared with what the Committee may have been led to expect, the above may seem very high estimates, and probably extravagantly high sums total, for the completion of the entire quays from "Newcastle bridge" to "Ouseburn" But it is my duty to state fully what I find the expense will be to construct the quays in the best manner and to the full extent, in order that the Committee may form a correct judgment of the plan to be adopted, and of how much the means of the corporation will enable them to carry into effect.

Taking into account the vast improvement that upwards of 4000 feet of good wide durable quays would be the town, and to commerce in general, by the facilities it would afford to shipping, and taking into account, also, the immense additional value it would put upon the corporation property, along the greatest part of which, as I understood, the new quays are to be constructed, it is worth a serious consideration as to how far the improved value will justify the expense, and whether the outlay for new quays will not ultimately be repaid by the joint effects of increased rentals, and improved shipping accommodation, upon what would then be most probably the finest quay in Europe.

Before quitting the subject of quays it may be proper, perhaps, to advert to the proposed accommodation for East India shipping at "Dent's Hole," the situation for which I carefully inspected when at Newcastle, together with the nature and probable effects of "Friar's Goose Point," and the erection of a line of quays westward, from that point to Tyne Main Staith.

Dent's Hole is particularly well adapted for the erection of a wharf, at which large vessels might be afloat at all times of tide, viz., vessels drawing from 16 to 18 or even 20 feet. The bottom of this place being composed of rock affords a good foundation for a wharf, which would have to be constructed up to the level of low water by means of the diving bell.

The cost of building a good stone quay at this place, with 20 feet depth in front at low water, would be at the rate of £40 per foot run, to whatever extent it might be carried, and with 16 feet depth at low water in front the cost would be £30 per foot run. Consequently, a wharf 1000 feet run, with from 16 to 20 feet depth close in front at low water, would cost from £30,000 to £40.000, as the case might be, and shorter lengths of course in proportion. But taking into account all the requisites of warehouses, approaches, and all other matters connected with an East India trade establishment at this place, even on a moderate scale, I think a smaller outlay than £50,000 should not be calculated upon.

As regards the removal of "Friar's Goose Point" I should advise that little be done further than dredging or deepening the channel as close as possible to the point at high water mark.

Enclosing the low water strand by the continuation of a quay from "Friar's Goose Point" to the Tyne Main Staith, or at all events contracting the river by groining or embanking at that point, is necessary, as is also dredging away the shoals opposite, above "Dent's Hole," between that and St. Peter's quay.

As regards Bill Point, the Committee cannot proceed better than as at present, by removing as much of the projecting rock as possible above low water, as every cubic yard of this point taken away not only improves the navigation at present, but goes towards the improvement of the channel itself at that point at some future period.

2nd. Of the Improvement of the River Channel.

This is a most important branch of the general improvement of the navigation of the Tyne from Newcastle bridge to the sea; and as it must necessarily occupy considerable time, as well as entail great expense, the best method will be to establish some general plan of proceeding, and then commence with those parts of the river which at present offer the greatest obstruction to the navigation.

The general mode of proceeding will be by groyning off the great bends or slakes on either side the river, according to the line laid down on Mr Rennie's plan, or such modification thereof as circumstances may render advisable; dredging out a navigable channel between those lines, depositing the soil raised on the shores of those parts of the river taken off by the groynes; and, finally, by lining and securing the new banks or shores of the river with stone rubble, in order that they may keep their form and situation, and that the new navigable channel may be maintained at the requisite depth on being once dredged out, after the sides of the river are brought to their proper height and form.

The best place to begin these operations must of course be decided by the Committee, under the advice of pilots and others best acquainted with the navigation of the river, and the particular parts requiring the most immediate attention; but, as far as my own personal observation went on my inspection of the river, it appeared that the very wide part of the river, occupied by the "Cock Crow Sands," from the 4½ to the 5½ miles, is that in which enclosing and dredging should first commence, by groyning off the large bend extending from "Hoyle's Copper Works" to a little below "Wallsend Coal Spouts," and which may with propriety perhaps be called "Wallsend Slake," containing about 60 acres which might be reclaimed, and laid to the adjoining land, with deep water all along it, to which the coal staiths might be extended, or to which lines they should, in fact, in the first instance be extended, as the very first step towards improvement, as the piling and framing for the stages and railway roads would form the very best groynes for intercepting the current.

Between the groynes thus formed and others, might be deposited all the soil raised by dredging, in making the new channel, and perhaps all the ballast of the vessels frequenting the coal staiths, which added to the natural silting from the tides, would in a very short space of time bring the whole of the enclosed space up to high water mark, the "Cock Crow Sands" would gradually disappear, and a good deep water channel be maintained all along the line formed by the groynes and coal staiths.

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The above being done on the worst part of the channel, other shoal places can be resorted to and improved by dredging, so that in a very short time many of the worst parts of the navigation may be deepened from one to two or more feet as a preliminary step; but I apprehend that when the measures for the improvement of the river are in full operation, one dredger will not be sufficient for the purpose.

In the commencement of important operations like those contemplated in this report, and more especially in the operations of dredging, which must necessarily be a work of some duration, it is of essential consequence that it be set about in the most perfect manner, not only as regards the plan and details of the dredging vessel and machinery, but also as to the system or mode to be pursued in the use of them. The great object is (or should be) to be able to dredge out of any given width a perfectly flat and level bottom to a channel, with a tide either rising or falling, and that without let or hindrance to the vessels navigating the river. For this purpose I should advise that means be taken to have the master and men appointed to the dredger well instructed in the business, and taught how to work the machinery with the best effect to preserve a constant depth of water with a rapidly rising or falling tide.

With regard to the cost of dredging, I am of opinion that to keep one engine fairly at work, boat away, and unload the soil raised in the most convenient and useful situations, will require on an average about £50 per week, for which at least 2000 tons should on the average be raised and deposited.

Having thus gone through the principle matters referred to my consideration, it will remain for the Committee to decide on the extent of the operations they will carry into effect, which must of course be governed by the annual amount that can be disposable for the purposes of improvement to the navigation of the river. As an approximation to this object, I shall take leave to suggest that something like the following would probably be the smallest scale of annual expenditure, on which the measure could proceed with advantage:—

Dredging 50 weeks, at £50 per week	£2,500
Works of groyning and contracting the river to render the dredging effectual will probable be at least equal thereto	2,500
300 feet run of new quay wall per annum, at £15	4,500
Sundries	500
Total	£10,000

I have, &c.,
W. CUBITT.

To the Chairman and Committee of the
Conservators of the river Tyne.

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No 193.
Brooks's Report on the Navigation of the River Tyne.

Report by W. A. BROOKS, Esq., C.E., *on the Improvement of the River Tyne.*

Engineer's Office, Guildhall, December, 1842.

SIR,

In pursuance of the resolution of your Committee, I have delineated upon the accompanying chart of the river Tyne the works which have been already executed, as well as those which, in my humble opinion, will be found necessary to be constructed, in order to effect the required improvement of the navigation of the river.

It appears that when the late Mr. Rennie was called upon to give his views for the improvement of the Tyne, its banks were not at that time so much covered with manufactories, commercial establishments, and coal-staiths, as we find them at the present day; and it was probably owing to that cause that we find on several portions of his plan evidence of his opinion, that the establishments which existed were not of sufficient importance to cause him to revolve in his mind, whether the removal of the shoals could not be effected by a different disposition or arrangement of the works to form the improved sailing course? Hence we find upon Mr. Rennie's survey only two shipping places for coal on the long line of shore between Howdon and Hay Hill Point, where at present there are eleven staiths, the whole of which would have to be carried out into the river for an average length of 363 feet, in order to reach the line of northern shore proposed by Mr. Rennie. Now if it were really essential in this instance to adhere to the above line of northern shore in order to effect the general improvement of the navigation, there could be no impropriety in calling upon the several proprietors of the above staiths to extend them to the line on Mr. Rennie's plan.

From the commencement of my duties as engineer to the corporation, my earnest attention has been given to this question, and the conclusion which I have arrived at is, that it is not, in this division of the river, at all requisite to adhere to the shore lines marked out by the late Mr. Rennie between the works at Willington and Hay Hill Point. All that is truly requisite for the improvement of the navigation here is fully to carry out his principle of leading the currents of ebb and flood into a single channel.

This object may be effected without prejudicing the establishments between the works at Willington and Hay Hill Point, and also without interfering with the docks at South Shields and Howdon.

The blue lines on the accompanying plan represent the improved navigable channel, which I have the honour to be allowed to submit as a substitute for the channel described by Mr. Rennie for this division of the river.

I have the satisfaction of being able to call your attention to the circumstance that I have shown upon the accompanying plan, that this deviation can be effected without making any sacrifice of the navigable advantages which would also undoubtedly be obtained by Mr. Rennie's design, supposing the increased expenditure which must be incurred to carry out the latter were not an object.

I am of opinion that the design which I beg leave to substitute can be carried into effect at less than one half of Mr. Rennie's.

By the arrangement proposed in the accompanying plan, it will not be necessary for the corporation to construct any works on the north shore of the river between Howdon and White Hill Point; whereas to carry the views propounded by Mr. Rennie into execution, it would be requisite to construct the works planned by that eminent engineer for both shores.

By the adoption of Mr. Rennie's plan a new line of shore must be formed considerably in advance of the docks at South Shields, below Jarrow Slake, as well as in front of the dock at Howdon, but by the execution of the plan which I have submitted, the docks in question cannot be affected.

Jarrow Quay.—The staiths on Jarrow quay will alone have to be lengthened to about the same distance into the river to which those on the northern shore have been already extended with such good results. By this extension of the Jarrow staiths, they will have secured to them the great advantage of shipment on a concave shore, enjoying permanent deep water in consequence of the flood and ebb currents being made to run in the same channel.

Willington Quay.—Higher up the river, the next shipping establishment which will be affected by my plan is that on Willington Quay, the property of the corporation, which by either of the above referred to designs must be carried further out, or into the true run of the tide.

Hebburn and Walker.—In the neighbourhood of Hebburn staith, as well as for the whole course of the river as far as Mr. Reay's quay at Walker, it will be seen by the accompanying plan, as well as by my report to your committee of the 29th September, that I consider it advisable to adhere generally to Mr. Rennie's line of new northern shore, the only alteration of which will be a slight modification, in order to obtain a proper connexion between Mr. Rennie's general design and the alterations proposed by me for the channel below Willington.

Walker and Bill Point Reach.—A deviation is necessary to be made in Mr. Rennie's line for the north shore of the reach between Walker and Bill Point. This line of shore should form a tangent to the great curve connecting it with the Willington Reach, which is the only practical means for improving this division of the Tyne.

Bill Point.—At Bill Point an important improvement has been already effected, so far as regards the diminished risk of vessels encountering each other on sailing round the Point; but I have to report that the navigation itself has become still more tortuous than formerly, owing to the want of the simultaneous construction of groins or jetties from the shore of the corporation estate above the Point.

So difficult is the present navigation of this part of the river, that for the prevention of damage to each other's vessels, a mutual agreement appears to have been established among the masters of the steam-boats, that only one vessel at a time shall pass through the narrow and tortuous channel above the Point. This is a portion of the river which I beg respectfully to press upon the immediate attention of the River Committee.

On reference to Mr. Rennie's plan, I find that it was designed to construct five stone groins in the bight formed by the north shore above Bill Point, in addition to four groins on the opposite shore.

If, however, the whole of these nine groins were executed, the obstruction to the navigation would remain in the shape of the great sand-bank which now stretches over five-sixths of the high water width of the river; the flood and ebb currents would still continue to run in different channels.

In this portion of the river I recommend the construction of the three jetties delineated on the accompanying plan, which will rapidly scour away the shoal by their direction upon it of the strength of the ebb, and at the same time will procure an easier sailing course round the Point than could be produced by the plan proposed by Mr. Rennie.

Saint Anthony's.—At Saint Anthony's it will not be necessary to encounter a twentieth of the expense which would have to be incurred in carrying out Mr. Rennie's design, which here requires the removal of a considerable portion of the Point and north shore, land, and houses.

I do not consider it advisable to undertake any works on this north shore at St. Anthony's, as a deeper and easier navigable channel can be procured, at a small expense, by the construction of the jetties, laid down on the accompanying plan, in the bight formed by the opposite or southern shore. These jetties will have the effect of removing the shoals at St. Anthony's; but it is, however, probable that the valuable quay accommodation which will be obtained by the adoption of this new line of southern shore, will induce the proprietors of the latter to petition the corporation for leave to construct quays in lieu of the above proposed jetties. Upon this view I am in hopes that it will not be necessary for the corporation to make any disbursements for the improvement of the navigation between St. Anthony's and Friar's Goose Points.

Dent's Hole and St. Peter's.—At St. Peter's the commencement of an improved navigation has been effected by the construction of several handsome stone quays on the north shore, and a still more important work is now under the consideration of your committee, in an application from Messrs. Thomas and William Smith to construct an extensive quay at Dent's Hole, which, if carried into effect, will remove a considerable portion of the great shoal at St. Peter's, increase the extent of deep water berths in Dent's Hole for vesels of large draught, as well as remove the latter more out of the navigable track.

The entire removal of the great shoal at St. Peter's cannot, however, be procured without the construction of additional jetties, or groins, on the opposite concave shore, as advised by Mr. Rennie, but those groins will have to be extended to the blue line on the accompanying plan. The views entertained by Mr. Rennie, for the removal of the greater portion of the ground and rock covered by the Friar's Goose alkali works, quays, Ballast-hill, &c., not being in my humble opinion practicable, on account of the great outlay which would have to be incurred for an object of at least questionable advantage, inasmuch as the removal of the quays, &c., would still leave a rocky bed.

Newcastle Reach.—Mr. Rennie's plan requires the removal of a considerable extent of the shore on the south side of the river, opposite Ouseburn, but as this portion of the navigation is already sufficient easy and comparatively deep, I do not perceive the necessity for any expenditure upon it, except for the improvement of the quays, and to obtain deep water berths in front of them.

General Remarks.—For the improvement of the navigation between Newcastle and Shields, so far as regards the removal of the shoals and straightening of the navigable channel, by the construction of jetties to bring the currents of the flood and ebb to run in the same bed, the entire expenditure will scarcely exceed 17,000*l.*, as per annexed approximate estimate, upon which, however, I place considerable reliance, as it is based upon extensive experience, and there being, in my opinion, a reasonable prospect of obtaining materials at cheaper rates than were paid at those works from which my data have been obtained.

On the completion of the jetties which I have in this report recommended, I feel confident that the trade of the port will derive very great and almost immediate advantages; for, not only will the shoals of the Tyne be scoured away, but a general reduction or lowering of the bed of the river, and con-

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sequent depression of the low water surface will take place, and the result will be, that vessels of much greater draught than at present will be enabled to sail up to the quay at Newcastle.

In the improved state of the navigation of the Tyne, consequent upon the construction of the above described works, there will not be found to exist a difference of more than 18 inches between the rise of tide at Newcastle and that which takes place at Shields; so that, with a flow of 15 feet at the latter place, there will be 13 feet 6 inches at Newcastle, and if to the latter be added the available depth at low water which will be obtained by the improvement, I think it quite reasonable to expect that the proposed outlay of 17,000*l.* will enable vessels of 17 feet draught of water to reach with facility the quay at Newcastle in ordinary spring tides.

I consider it advisable that the works for the removal of the shoals from the bed of the Tyne should take precedence of the construction of any very considerable extension of the new quay, because the removal of the shoals, and consequent depression of the low water line, will enable the masonry of additional quays to be founded at a lower level, and with consequent diminished cost and increased stability.

On the completion of the long jetties at Wallsend, now in the course of being constructed, and for the materials and labour for which you have entered into contracts below my estimate, I beg to be allowed to recommend to the committee the construction, in the first instance, of the jetties delineated on the plan in the vicinity of the Heaton, Wallsend, and Killingworth Staiths, which on an estimate founded on the present sections of the channel, will require an outlay of 1,584*l.*, but which will, in my opinion, be executed at a cost of 1,000*l.* by reason of the rapid deposition of mud and sand which will necessarily take place in consequence of the construction of the jetties already ordered to be proceeded with. This accretion on the sites of the proposed jetties will diminish the quantity of materials which would otherwise be required in their formation, assuming that they were proceeded with, without regard to the useful effect which may be produced by a judicious arrangement of their order of procedure.

In a previous division of this report I have urged the necessity for immediately constructing three jetties in the bight of the north shore above Bill Point, the cost of which, as per annexed estimate, will be 845*l.*

I feel assured, Sir, that the advantages, which will be immediately experienced by the execution of the works at Wallsend and Bill Point will create a strong desire among the members of the corporation for the early accomplishment of the remaining improvements described in this report, and which will not require more than two years to execute, whenever the necessary funds shall be available.

I have, &c.,
W. A. Brooks.

To the Chairman of the River Committee.

Estimate for the removal of the Shoals, consisting of sand, from the channel of the River Tyne between Newcastle and Hay Hill Point.

	£.	s.
Cost of five jetties as per plan, in the bight opposite St. Peter's .	805	0
Do. three do. opposite St. Anthony's	906	10
Do. three do. in the bight above Bill Point	845	0
Do. seven do. in Bill Reach, or Long Reach	1,353	0
Do. six do. in the bight below Walker	2,970	0
Do. one jetty at Willington	594	0
Do. seven jetties on the Jarrow shore	3,613	0
Do. five do. on the north shore of Jarrow Slake . . .	4,405	10
	15,492	10
For stone, clay, and other contingent expenses in the construction of the above jetties, 10 per cent.	1,549	5
	£17,041	15

The engineer will attend at his office in the Guildhall on Tuesday the 24th, and Wednesday the 25th days of January instant, to exhibit and explain the plans of the contemplated improvements to members of the Council.

No. 194.

Walker's Report on the proposed Quay, Wall, and Embankment, at Dent's Hole, Newcastle.

No. 194.

Mr. Walker's *Report on the proposed line of Quay, Wall, and Embankment, at Dent's Hole.*

No. 23, *Great George Street, Westminster,* 12*th January,* 1844.

On the following points there is no difference of opinion:—

That Dent's Hole affords the best berths in the harbour for heavy vessels, and that it ought not to be injuriously interfered with.

That the river there, being already narrow and curved, the tiers ought not to be projected further into the river, so as to interrupt the navigation of passing vessels, more than they do at present.

That the road-way and stairs proposed to be made by Messrs. Smith and Company, if an embankment be made by them, would be public improvements.

That an extension of Messrs. Smith's trade would be the probable consequence of an improvement and enlargement of their premises, and would, by the employment of more hands and more capital, be useful to the public, and particularly to the town of Newcastle.

Keeping in view the general agreement on the main points, I hope to show that there is really no difference as to the interests of the parties in working out the detail.

The witnesses in favour of the extended embankment, as last applied for by Messrs. Smith, state as one of its advantages, that the tiers may in consequence of it be brought nearer to the shore than they are at present. Supposing, however, that no advantage is taken of this, and that they remain in their present position, which is as much as ought to be expected, then adopting their opinion, that the embankment will not prejudice the public occupation of Dent's Hole, and that Messrs. Smith would not object to bind themselves to this, there should be, in addition to the width of a keel for getting

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alongside the inner tier, a sufficient space between the tiers and the front of the new wall, for at least one ship to lie, to load and unload, if the premises are to be occupied as a commercial wharf, or to have her upper works repaired, if the premises are to be occupied as a ship-builder's yard. This clear space in front of the wharf would probably be of more value to Messrs. Smith than the wharf itself; at least the wharf would be of little use unless ships could get to it. Thus far the interests of both parties appear the same. Now if we take 40 feet for the supposed ship, and 20 feet for the keel, it appears that 60 feet from the front of the new wharf to the inside of the tier will be about the proper width for the convenience of both parties. I do not mean that the 40 feet should be exclusively Messrs. Smiths', but that they should have the same use of it for their purposes, as other owners similarly situated have of the river in front of their premises. The obstructions by vessels lying at their wharf should not extend beyond this, it being understood that the supposed 20 feet are to be for the convenience of vessels loading or unloading in the tiers. Thus much for distance. Then if Messrs. Smith are to be at the expense of making the quay, I think the condition of obliging them to erect mooring posts and mooring rings upon and in front of it, for mooring vessels in their tiers, should be dispensed with, as being likely both to annoy them and the public, by intersecting the passage inside the tiers. In so important a place as Dent's Hole, the commissioners should have their own mooring in the river, and the making fast to posts and rings upon Messrs. Smiths' quay should be for temporary purposes only.

Having received from Mr. Thomas Smith, pilot-master, a correct plan made at my request by Messrs. Sopwith and Scott, to show the position of the ships in their berths at Dent's Hole, I have upon the principles above stated, laid down upon the accompanying copy of the plan, a line which is nowhere less than 60 feet distance from the inside of the inner tier.*

This line I beg to recommend, and if any modification of it be thought desirable, I would strongly advise that it be made upon principle, and without reference to lines formerly proposed, or to the engineers who have proposed them. The line I have drawn turns out to be nearly a medium between the proposals of Mr. Anderson and Mr. Brooks, but was laid down in the way I have stated without a reference to either of them.

I feel assured, after the best consideration that I can give to the subject, that there is nothing in the particular line I have recommended, which will injuriously affect the general allinement of the river.

The excavation in front of the proposed quay to at least 10 feet below low water should, I think, be done at Messrs. Smith's cost. This will compensate in part for the diminution of the width of the water-way.

The moorings in the river should, I think, be laid down at the expense of the commissioners.

The details as to the roads, stairs, &c., I have not interfered with, and the care that any agreement entered into between the parties be so made as to be legally binding and operative after the work shall be executed, will no doubt be committed to Mr. Clayton, and may safely be left in his hands.

J. WALKER.

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No. 195.

Murray's Reports on the River Tyne.

Reports by JOHN MURRAY, Esq., *on the River Tyne Improvements.*

SIR,

Sunderland, 8th November, 1844.

During the spring tides on the 14th and 15th of October last, I was engaged with Mr. Brooks, your engineer, inspecting the river Tyne from Heaton to Hayhole Staiths. On the 29th ultimo I also surveyed the river at the period of low water in the neighbourhood of White Hill Point, and considered the effects likely to be produced on Shields Harbour by the contemplated works above, and I have taken such dimensions and soundings as seemed to me necessary for understanding the locality of this important section of the river.

It appears that certain jetties have been for some time past in course of execution in the wide part of the river at Wall's End, which have partially diverted the strength of the ebb tide, and made it act with force upon the extensive sand banks lying in the middle of the river. What formerly was a long flat, nearly dry at low water, is now deepened several feet; and when the jetties are closed I have no doubt the full force of the ebb tide will scour it yet deeper, and effect a very considerable improvement in this part of the river. Unless, however, the jetty above Point Pleasant be erected, and the staith at Willington be prolonged and made to act likewise as a jetty, great injury may occur to the shipping places lower down, as the strength of the current now does and may yet run stronger into Wellington Gut, and be from thence diverted to the southern shore, which would have a tendency to increase the sand banks at Howdon. I am of opinion therefore with Mr Brooks, that these works should be executed forthwith, and to the full extent proposed by him; but I think it will be necessary to run out almost an intermediate jetty (which need not be an expensive one) midway between the two, to prevent an injurious eddy, which without it might be formed at Willington Gut. This I have shown in dotted lines on Mr. Brook's plan of the river.

I now come to the Ballast Wharf, midway between Howdon and Willington Staiths. This has been formed by a deposit of rubble stone, backed with ballast to the height of the adjoining quays, and at present projects about 95 yards into the river as a solid embankment. The execution of this work ought at all events to have been deferred, but having being executed *per se*, it has acted in my opinion injuriously; for jutting out into the stream, it has made a strong eddy below it, which has formed an extensive sand bank in front of Howdon Dock, and caused a silting up of the adjacent shipping places. If the river at Wall's End and at Willington remains unimproved, I am of opinion that a further silting up will take place at these shipping staiths, and therefore no time ought to be lost in completing the jetties above recommended.

I do not approve of this Ballast Wharf: in my opinion such an encroachment on the tideway ought not to have been permitted, as all the benefits of directing the flood and ebb currents could have been produced by jetties. It may be urged that the very effect of these jetties is to silt up between them, which I will grant to a certain extent, but it is a safer system of engineering to allow nature than art

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* To give a regular line of wall, one of the tiers, the third downwards, has been altered by me to ships of 28 feet, in place of 30 feet beam, which keeps the inner ship of that tier 6 feet further out.

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to do it. In course of time the waters will make a sloping shore from high to low water mark, which generally will be at the extremity of the jetties, and if this receptacle for tidal water be larger than necessary, it will fill up; and then is the time to take into consideration the expediency of enclosing it. When a river is in course of improvement, I think it better to defer any enclosure till the effects of the flood and ebb currents have fairly balanced themselves. In my opinion, therefore, great judgment ought to be exercised in permitting them, and the one in question ought not to be increased, as at a future period it may be deemed necessary to remove it altogether. The piling and timber work, however, in front of it ought to be taken away to allow the current to receive simultaneously a proper direction by the construction of the works above.

The future deep water of the river below the Ballast Wharf at Howdon is a matter of considerable importance, and the low water lines marked out by the late Mr. Rennie, and those now proposed by Mr. Brooks, are greatly at variance. If Mr. Rennie's lines be adopted, the waters of the river will undoubtedly have a direct course to the sea; and the strength of the ebb tide will be along the southern shore from Jarrow Staiths, skirting the Slake, and then acting on the sand at White Hill Point, which it will advantageously curtail, but the northern shore between Howdon and Hayhole Point will thus be left in an eddy. Again, the flood tide would also skirt Jarrow Slake, where not being interrupted, as it is now, by the sand which tails downward from Jarrow quay corner, it would pass directly up the river in the course of the ebb, leaving the northern shore likewise in an eddy. Consequently, both on the flood and ebb the tendency would be for this shore to become the shallow side of the river, and be ill adapted for the sites of coal staiths.

It appears when Mr. Rennie designed these low water lines, that only two shipping staiths were in existence immediately below Howdon, and therefore there was no great necessity for making deep water along that shore. As, however, a great many staiths are now erected there, it becomes a matter of importance to the owners to have the advantage of the deep water which they have till lately enjoyed: the conservators of the river will no doubt benefit its trade by granting them that indulgence, if it do not interfere with the general improvement of the river, especially as it can afford no commercial benefit to have deep water along the tail of Jarrow Slake.

The low water lines of Mr. Brooks are proposed to be effected by the erection of certain jetties on the southern shore, and the prolongation of the staiths at Jarrow; by which works, it is anticipated, these staiths will have deep water in front of them, and the ebb tide impinging upon them will be diverted to the opposite shore, making it concave, and consequently deep water, and well adapted for coal shipping purposes, without making much change in the ebb and flood currents through the high part of Shields harbour.

I am of opinion that the low water lines proposed by Mr. Brooks will have the effect of removing the shoals which now impede the navigation, and make deep water in front of the staiths at Jarrow on the south side, and at Seaton Delaval with the staiths to the right and left of them on the north side, but I much fear the upper staiths will still have shoal water in front of them, so long as the embankment at Howdon projects into the river.

In consequence of the sand, which will tail downwards from the lowest jetty at Jarrow quay corner, the flood tide will most likely be forced to the opposite shore, which would then be its best course. If this required assistance afterwards, it might be done by some slight jetty work on the low shore of the Slake immediately above the docks at South Shields.

I am however of opinion, that the lowest jetty on the south shore, as proposed by Mr. Brooks, near the Jarrow quay corner, should be placed 200 yards higher up the river, and the highest one brought 70 yards lower down. In other respects I approve of their position, and think with the addition of the one which I have suggested at Willington, that they may be executed for the sum of £4900.

I have, &c.,
JOHN MURRAY.

To the Chairman of the River Committee,
Newcastle.

SIR,

London, 2nd May, 1845.

On the 17th of April last, in company with your engineer Mr. Brooks, I surveyed the river Tyne from Newcastle downwards to Friar's Goose Point, and on that day, which happened to be particularly favourable for the purpose, I took various lines of soundings in the river, both longitudinally and transversely, from that point upwards to the quay now building by Messrs. Woods and Henderson. I did this with the view of giving you, as requested, my opinion on certain works projected between these places for the improvement of the river Tyne.

St. Peter's sand is not formed so much by the projection of Friar's Goose Point as seems to be generally imagined. The set of the ebb current coming through the water-way at the bridge of Newcastle impinges on the quay and low water shore below the Ouseburn Glass Works, and is diverted from thence into the southern shore of the river, between the Tyne Main Staiths and Friar's Goose Point. No works having been erected to prevent this action of the current, the banks have slidden down, and have been acted upon by the waters of the river until its high water breadth has been increased, while the breadth at low water has been at the same time diminished. Again, the flood tide is considerably affected by the bight below Messrs. Smith's ship-building-yard, and by the slip way itself, and is necessarily diverted to the concave shore above it on the south side. The ebb and flood currents having taken these courses for a series of years have made the river more tortuous, and formed an increase in the height and extent of St. Peter's sand.

It is quite evident that by prolonging the quay westward, from Friar's Goose Point into what is the main channel of the river, or beyond the present low water mark, the flood tide will not be swept into the bight, but have a more direct course upwards and tend to diminish the eddy on the opposite shore, and thus lessen the deposits on St. Peter's shoal.

Great stress is made both in Mr. Rennie's report and in others, on the removal of Friar's Goose Point, with the intention of straightening the river for its improvement. It appears to me that the great object is to give it one gradual increased width downwards, reducing it where too wide by artificial works, and removing the projections for more readily passing the ebbing waters; and at the same time allowing the flood waters to run more easily upward to increase the quantity as much as possible for the scouring process on the ebb.

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The lineal width of the river at high water is as follows:—

	Feet.
The water-way through the bridge at Newcastle is	320
At the old quay a little way below the bridge.	350
Below the Ouseburn Glass Works Quay, being the first bend in the river below the bridge	430
At Messrs. Woods & Henderson's Quay, now building, it will be .	405
At Friar's Goose Point	400
At Felling Shore Quay	395
At St. Anthony's Point	397

The width therefore at Friar's Goose Point is very nearly what it is intended to be at Messrs. Woods and Henderson's quay at half a mile above the point, and at St. Anthony's, nearly one mile below it.

If therefore the bed of the river at those places be deep enough at present (and if not so, yet of such a nature as to be capable of being acted upon by the current), so that the sectional area in all three be nearly alike, there is no necessity for increasing the width at Friar's Goose Point more than is necessary to overcome the additional friction which the curve or turn of the river at that place causes to the passage of the water.

The more this curve is eased, or in other words, the nearer the principal set of the waters are brought into a straight line the better. By doing so it will, in effect, be like an increased width to the river at the point, and allow the water to pass more readily up and down. Two ways present themselves to effect this object. The one is to cut off a portion of the point which is occupied with alkali buildings, and a ballast deposit.

The removal of these is certainly not impossible, but it must be attended with expense, as unfortunately the rock upon which the works are situated could only be removed below low water at great cost by the diving-bell or by cofferdams.

If taken off to any great extent, I am of opinion that. by increasing the sectional area there, a considerable lessening of the depth of water in Dent's Hole would be the consequence.

The other method is to straighten the river above and below the point, where necessary, by contraction; fortunately this may be done to a considerable extent in the bight of the river immediately above, which will not only have the effect of giving increased capacity to the section at the Friar's Point for venting water by diminishing the eddy alluded to, but it will have the desirable effect of preventing the earth and soil from falling down into the river from the high "sliding banks." By narrowing the river the shoal of St. Peter's will be materially lessened in breadth, in length, and in height.

The next question is to what extent this contraction may safely be carried. I have carefully considered this point, and on the accompanying copy of a plan received from Mr. Brooks, your engineer, I have laid down with a strong red line what I am of opinion ought to be the altered southern shore of the river, between Messrs. Woods & Henderson's quay, now building, and Friar's Goose Point, with the widths of the river in different places thereof. My opinion is not asked in what manner I would propose to accomplish this, but I think it right to state, that the direction of the curve can only be properly carried into execution by particular attention being paid to the situation of the quays proposed to be erected by Messrs. Allhusen, Turner, & Co., and the quays between their works and the Tyne Main staiths. A proper system of jetties below these staiths in the bight, if properly placed, will make the red line the southern shore, and which, I may here remark, may be lengthened or shortened when found necessary without much difficulty, as the more expensive quays above are carried into execution.

I am, &c.,
JOHN MURRAY.

To the Chairman of the River Committee,
Newcastle.

SUNDERLAND.
River Wear.

No. 196.

Evidence taken on the 31st Oct. 1845.

No. 196.

PORT OF SUNDERLAND—RIVER WEAR.

Examining Commissioners, AARON CHAPMAN, Esq., M.P., and Captain WASHINGTON, R.N.

Present:—CHRISTOPHER BRAMWELL, Esq.; J. J. WRIGHT, Esq., Solicitor to the River Wear Commissioners; THOMAS BROWN, Esq., Chairman of the Shipowners' Society of this Port; W. ORD, Esq., Chairman of the Pilotage Commission; J. S. ROBINSON, Esq., Clerk to the River Wear Commission, &c.; JOHN SCOTT, Esq., Chairman of the River Wear Commissioners; P. LAING, Esq.; ROBERT SCURFIELD, Esq.; HENRY TANNER, Esq.; G. W. WRIGHT, Esq., &c., &c.

Mr. J. S. ROBINSON stated he had been clerk to the Commissioners for three years; in that capacity he had made certain returns respecting the port to the House of Commons on the 6th of July and the 2nd of August, which returns were correct so far as he knew. The 2nd of Geo. IV. is the governing Act, all the clauses of which had been complied with. He could not state the exact number, but he believed there were upwards of 150 Commissioners appointed under this Act to manage the affairs of the port. A great many of them were shipowners, and he believed many of them had been sailors in their youth. A great many of the Commissioners were resident in Sunderland. Five were a quorum. The Commissioners must qualify every year; he could not say exactly how many of them had qualified for the present year; but he believed fully one hundred had. It was mostly those who resided at a distance who had not qualified; and such as the Duke of Cleveland, and one or two other noblemen. There were several who had been elected Commissioners, but who had never qualified at all. Vacancies in the Commission were filled up as they occurred, the appointments being made by the Commissioners themselves. They were self-elected. Their services were gratuitous. They commonly met once a month, and they elected their chairman once every six months; but the retiring chairman was eligible to re-election. The proceedings were entered in a minute book. The same individual did not act as clerk and treasurer. The annual accounts were audited by three Commissioners, and printed every year, and were open to the inspection of the rate-payers.

Mr. HARRISON, and several other shipowners present (not Commissioners), here exclaimed that the accounts had never been seen; and that if they, or any other person, not Commissioners, had applied to see them, they would have been refused.

Mr. ROBINSON.—A return of the accounts for the last ten years had lately been made to the House of Commons.

Mr. JOHN STORY.—He had been thirty years a shipowner, and on one occasion had a very particular reason for wishing to see the accounts, yet he had never been able to come at them.

Mr. ROBINSON remarked, that the act provided that it was only to the inspection of the Commissioners that the accounts were to be open under a penalty of 5*l*. It was not to the public.

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Mr. JONASSOHN made some remarks to show that something more should be done by the Commissioners than merely to show the accounts on application. The Commissioners were a close body, and as the public were not admitted, it was impossible that people could know when the accounts were made up and printed. As they did not give notice, it was not likely any individual would go to ask when the accounts would be published. That could only be known to the Commissioners themselves. There was no publicity given to their proceedings. Neither the public nor reporters were admitted to their meetings.

Mr. T. BROWN.—Perhaps it would ensure sufficient publicity amongst the shipowners, if copies of the accounts were furnished to the Shipowners' Society.

Mr. SCOTT states, that if application were made by proper parties to see the accounts, he had no doubt it would be complied with.

Mr. ROBINSON.—The Commissioners of the River Wear were empowered to make bye-laws; but they had made but few, and these principally in reference to steam-boats. The regulations for the Government of the port, and the bye-laws had been duly printed and published. The port dues were levied upon ships for only three voyages in the year, and they might make a dozen voyages without being charged on more than three. Upon these three voyages 1*d*. per ton was paid, and that was the entire charge upon ships trading from this to any other port.

[Reference was here made to what is called refuge dues, any vessel calling at this port and leaving it to go to the Tyne, Seaham, or any other port, for loading to some other port, either coastwise or foreign, being dealt with as if she called for refuge, even though she could call with the finest wind, and in the finest weather, and accordingly charged 1½*d*. per ton. Mr. Robinson admitted this was charged in addition to the usual port charge of 1*d*. per ton upon each of their voyages, upon which various shipowners were proceeding to complain of such an outrageous imposition as charging a ship for refuge, which, in fact, was no refuge at all; when Mr. Scott deprecated the discussion at present, as the shipowners having formally objected to the charge, the matter was to be submitted to the opinion of counsel.]

Mr. ROBINSON.—Their act gave the Commissioners power to build quays and otherwise improve the barbour; to construct piers; and to deepen and to enlarge the channel of the river. It directed that once every year the harbour should be surveyed, which was done by the engineer and thirteen of the Commissioners. The jurisdiction of the Commissioners extended as far as Biddick Ford, about 8½ miles up the river. And their boundaries at the outlet of the harbour were the Mere Stones. There were three harbour-masters to direct the moorings of the ships in the harbour; in doing which they had instructions from the Commissioners, which they were empowered to carry out, there being a penalty for disobeying them.

Mr. T. ORD here observed that great complaints had been made as to the mooring of ships, and he hoped the system of mooring would be thoroughly inquired into, as it was a most important matter.

Mr. ROBINSON.—The Commissioners were empowered to borrow money, and they had accordingly borrowed 37,000*l*., 10,000*l*. of which was at 4 per cent., and the remainder at 4 per cent. interest. Occasionally ballast was cast into the harbour, but the parties were always summoned before the magistrates and fined. There was no passing toll upon shipping. Generally speaking, the whole of the clauses in the Act had been complied with. He had stated in his letter to the Secretary of State that no complaints had reached the Commissioners of the working of the Act. The treasurer would speak to the accounts.

Capt. WILLIAM HILL, Treasurer to the Commissioners, said, the income of the Commissioners amounted to about 16,000*l*. annually, which was the amount of the dues levied upon the whole of the shipping. There was no other body in Sunderland which levied dues. But the Trinity House of Newcastle levied a toll upon shipping which amounted to about 1600*l*. or 1800*l*. a-year, which did not go to the improvement of the port. There was also a toll upon anchorage and beaconage, amounting to about 400*l*. a-year, which went to the Bishop of Durham; but none of which was expended in the improvement of the port.

Mr. W. ORD complained heavily of this application of the money. The Bishop of Durham, or whoever received this tax upon buoys and beacons, ought to keep them in repair, but it was not done. He did not contribute a single sixpence. Thus a revenue was derived from, without a farthing of it being expended upon the port.

A body of Commissioners act under the River Wear Watch Act. Mr. Kidson was the clerk, and Mr. Moon the treasurer. Their revenue was about 1400*l*. a-year. It has given great satisfaction. There is a river police for watching; and a fire-engine, which is very efficient.

The TREASURER.—The whole of the 16,000*l*. is applied to the improvement of the port, with the exception of paying expenses, and the interest on the money borrowed.

Mr. SCOTT.—We applied for an Act of Parliament to have the river converted into a Floating Dock—but we never got into committee—which cost about 2000*l*. Other 1500*l*. was expended in relation to that project. There were no charges for law expenses.

The Merchant Seaman's Fund it was stated, was managed by fifteen trustees, who were chosen annually. It was raised by 1*s*. per month levied upon all seamen belonging to the port, and 2*s*. upon masters. Seamen considered it a very great hardship that this contribution should be made compulsory upon them, when no such provision for themselves was made compulsory upon any other class of men. At present there was upwards of 2070*l*. in an annuity fund.

Mr. S. J. HOWE.—What made them find fault was, that if they had occasion to apply for parish relief, the parish gave them so much less on account of their receiving from the Muster Roll Fund. At least this had occurred.

The COMMISSIONERS trusted this would not occur again. The sailor ought to have his full amount of relief, because he of all man worked well for it.

Primage and other Dues.

Mr. JONASSHON here called attention to a tax denominated primage, which was levied upon all merchandise that entered this port, and which was received by the Trinity House of Newcastle-upon-Tyne. It was not received at the Custom House, or according to any custom house scale; but was received by Mr. Simpson or his clerk. He had often applied, but had never been able to obtain an exact scale of this charge, or how it was applied.

COMMISSIONERS.—We have now in our hands a list of all the charges upon shipping, and it may be satisfactory to know what they are. These are the harbour dues: the rent for beaconage to the Bishop of Durham of 1*s* 2*d*. upon every ship for every voyage she makes; there is the river duty of 1*d*. per ton; the refuge dues; the river watch; the life-boat; Whitby dues; Dover harbour duty; Ramsgate harbour duty; dues for the Newcastle-upon-Tyne Trinity House, for ships under 100 tons 11*d*. a ship, and 15*d*. for a ship of 300 tons; fairways and buoys, 1*s*. per ship; pilotage under the same authority, and for ballast you pay under the same authority.

Mr. SIMPSON said primage was collected by the Trinity House of Newcastle-upon-Tyne; it was levied upon all goods imported from abroad here; the charge upon timber was 2¼*d*. per load; upon tallow, 2*d*. per ton; hemp, the same; tar, 3*d*. per last (about two tons); and a trifling charge was made upon every other thing imported from abroad. When the articles were imported in foreign ships they did not pay more than British; they once did, he believed, but they did not do so now.

Mr. LAING complained of paying the Trinity House of Newcastle money. It was a system only suited

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to a period 200 years ago, when Newcastle had jurisdiction over all the ports extending southward as far, he believed, as Whitby. But Sunderland was now in a very different state from what it was 200 years ago, and not in the slightest degree dependent upon Newcastle. He therefore decidedly objected to paying money to that port.

Mr. SIMPSON, in answer to a question, said the amount of the primage was about 200*l.* a year.

Mr. T. ORD.—Yet there was not one farthing of it expended upon the port; it all went away.

Mr. THOMAS BROWN instanced resident Commissioners of Pilotage being appointed at Sunderland, as a case in which the Trinity House had shown themselves anxious to consult the general feeling in this port. He mentioned this to give them credit where they deserved it.

Encroachments on the River.

The COMMISSIONERS inquired whether any complaints had come before the Commissioners with respect to encroachments upon the bounds of the River.

Mr. ROBINSON.—There were some which were now under the consideration of the Commissioners. One was on Mr Reay's property at Hylton, where, owing to a ship-building yard, there was an accumulation of soil which prevented the free flow of the water—which, in fact, kept back the water from where it would flow. There was another encroachment at Claxheaugh, belonging to Mr. Scurfield, where a quay had been built into the river, and the proprietor of which had orders to remove the encroachment. There was also one at the entrance to the North Dock, which was formed for the protection of the coffer-dam when the dock was first made—the proprietors undertaking to remove it when called upon; the Commissioners had required them to remove it, which they had complied with to some extent, but they would have considerable difficulty in removing the whole. These were all the complaints there were of encroachments.

How far up the river does the tide flow?—At spring tide the tide flows up twelve miles from the ends of the piers.

Mr. GUY POTTS, harbour-master, examined.—He was harbour-master and pilot-master, and had been so for 25 years. Had been acquainted with the port since boyhood, about 50 years ago. There was then a North pier and a South pier too, half-tide stone piers, with carcases on the top. There was then no swell in the harbour—no complaints of it, at any rate; there was not then such a depth of water on the bar as there was now, the height at high water on the bar then being only about nine feet, and he had gone across the bar dry, while now the tide rose sixteen feet. The harbour also had been deepened.

Mr. COOK.—As the piers had been carried farther out to sea, the bar had been carried out also.

Mr. POTTS.—About fifty years ago a light vessel would wash over the bar at high water. Improvements to the harbour had been going on for some time, but never so much as within the last six years; indeed, within the last six years they had been going on very rapidly. The half-tide stone piers were converted into whole-tide stone piers scarcely twenty years ago. He knew nothing about the foundations of the old piers. Mr. Shout was the first engineer of the port—then Mr. Pickernell. Mr. Shout built the North Pier, and Mr. Pickernell came before it was finished, and extended a part of the North Pier beyond the lighthouse. Mr. Milton and Mr. Murray were the next resident engineers. Mr. Milton was engineer when, about 1819, Mr. Rennie, the engineer, was called in, who gave the plans of the present piers, which had been going on under his direction ever since His duties as harbour-master were to see the ships moored. There were plenty of moorings. They called some of the mooring-posts private property. Some of the ships were moored to rings in the river: there were buoys above, firm posts to which these rings and buoys were attached being put under the bed of the river fourteen feet. The ships were moored head and stern—generally with the heads down; but ships laying up for the winter generally had their heads up. He had known vessels break away from their moorings, the cause of which was in some instances the chains breaking, and in others the moorings giving way.

Mr. T. ORD here described the evils of this plan. Several ships were fastened to one ring or mooring, and when it gave way, as was often the case, the whole of the ships attached to each other were turned adrift, and left to run against and drag each other

Mr. POTTS said his district of the river was from the bridge to the ferry-boat landing. In 1841 a great quantity of ice came down the river, broke the ships adrift from their moorings, and did a great deal of damage, amounting to about 30,000*l.* or 40,000*l* Since then steps had been taken to moor the ships more securely. Stronger moorings had been laid down, and in some parts double moorings were laid down where they were required. Since then none had broken adrift. He, as harbour-master, did not point out these things. Proper moorings had only been laid down in certain parts of the river. At the time of the disaster in 1841 there was a great want of mooring-posts, of which he had complained many times to the Commissioners. The people who owned the quays on shore had claimed, and still claimed, these posts as private property, and required toll for them. The quays along the side of the river were private property, and dues were claimed for using them. If a ship lay on the North side, Sir Hedworth charged 2*s.* for the moorings, 1*s.* for each end of the ship: at the South side it was 6*d.* for each end.

Mr. POTTS: About fourteen double moorings had been laid down: perhaps other ten were required. Sometimes there were as many as twelve sail forming one tier, and these twelve all hung by one mooring. He did not know how many ships broke loose in 1841, but almost every ship in the river. When any person threw ballast in the river, it was his duty to give information against him, and he was brought before the magistrates and fined. The ballast was taken out to sea about a mile and a half, to where a certain buoy was placed with S marked upon it, where the depth was five fathoms at low and seven at high water. In consequence of the heavy swell caused in the river by the roughness of the sea in strong gales from the eastward, he had seen vessels break from their moorings. Great alterations were in consequence making in the South Pier. A beaching-place had been formed in the South Pier for the sea as it rolled in to expend itself, and since then in a rough sea the river was much quieter. Both piers were in an excellent state, but the South Pier was scarcely finished. The North Pier was as excellent a piece of masonry as any in the kingdom. It was carried farther out into the sea by Mr. Murray. The lighthouse was then moved, from where it had previously stood, to the end of the part which had been added. The South Pier was in a good state. The end was guarded very well, and so secure that he did believe no "sea" would move the upper stones from their places. Some of the stones had indeed been moved, but that was caused by ships striking against the end in rough weather. He had seen ships strike against the pier, and then come into the harbour; but he had seen others, on striking, go behind the pier and be wrecked, but the lives were generally saved. There were plenty of mooring-posts on the pier, but no hawser, and had not been for the last thirteen years. In calm weather the ships were mostly towed in by steamers, and in a storm there were lines on the pier ready to be thrown aboard the ships, where they were fastened to the hawsers. If the harbour had a southern outlet, ships would get out when they could not at present, owing to the wind. They would be the better of a dock. There was a North Dock, but ships generally did not go there—one cause of which was the want of water, and it was a bad place for ships to get in when laden. When a ship was laden, she could not get to the North Dock from the sea, and a laden ship in the harbour when it could get to the Dock could get as well to sea. There was another place where a dock might be formed. A plan for it had been published, but only lately. There had been a plan before, about six or eight years ago, which was not carried out, because an act of Parliament could not be obtained. He would put the outlet of the Dock by Hendon, which would let ships go out direct south-east to sea. There was deep water all the way there.

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The best entrance would be at Crab-hill or Coble-dean. He would have the outlet of the Dock by the south end of Crab-hill to the north of the Dove-rock. He preferred that place because there was deep water on both sides. He had no doubt a south bar would be a very great benefit to the shipping of the port; there would be less sand there because it would be more sheltered; it would be sheltered at high water. Crab-hill was a high place, and had the sea at all times breaking up the rocks. There were about five fathoms at high water. Upon these rocks at low water it would be sixteen feet. Was pilot-master as well as harbour-master, and examined the pilots for the board.

Mr. W. ORD said the Commissioners of Pilotage for the port made the examinations, but the pilot-master assisted them as much as possible.

Mr. POTTS said he took the depths of water at the bar frequently both at high and low water. Generally speaking the bar was improved, and improving. He had full power with respect to the moorings, and if he felt his powers insufficient he had only to apply to the Commissioners for more. There were 140 pilots belonging to the port; they were examined by Commissioners in this port, and received branch licenses. [The major part of the Commissioners had been sailors.] He assisted them in the examination. [It had previously been explained that formerly the pilots were examined and appointed immediately under the authority of the Trinity House of Newcastle, but that within the last year or two the pilotage of the port had been under the control of Commissioners, consisting of shipowners, &c., belonging to the port, appointed by or under the sanction of the Trinity House of Newcastle, and whose proceedings were taken cognizance of and generally confirmed by the Trinity House.] He had had no complaints of pilots running vessels ashore. A ship with a pilot lately run against the North Pier. None but vessels from foreign were compelled to take pilots. There were two life-boats in this harbour—one of which was kept in a house on the North Pier, the other at Hendon. Each was manned by ten men (who might volunteer for the purpose, who were paid so much per man from a charge of 6*d*. per ship upon vessels every voyage they made to this port), and had proved themselves very serviceable in wrecks. He had the charge of the life-boats, and they were in good order. Once a-year the boats were taken out to exercise; but it was long since they had them out.

Mr. JONASSOHN would ask the Harbour-master if no craft had broken adrift since 1841—whether the Commissioners' dredging-machine did not break adrift last winter and do much damage?

Mr. POTTS said the dredging-machine was not under his, but Mr. Murray's orders.

Mr. M. WAKE complained respecting the management of the life-boat on the north side. The last time the boat was required to go out she was not ready. There was a cloth over her, and the oars were not in her. Some time elapsed before she could be got off the slings. He had seen great neglect in the parties who should look to her not being in attendance. On this occasion it took full half an hour before the boat was got into the water. He was there himself the whole time; never saw the Harbour-Master, and believed he was not there.

The HARBOUR-MASTER asserted that he was there, and that the boat had been got into the water immediately.

Mr. E. BACKHOUSE.—He felt there was a loss of time, which arose from these and other circumstances, but he felt exceedingly diffident about making any charge. He really thought the thing should be better managed; but he brought no charge against any one. With respect to the life-boat, he had seen it exceedingly mismanaged. He was going to observe there was one very affecting case occurred a few years ago. It was the case of Nicholson's ship. Now, it did appear to him it was an extraordinary thing that these poor fellows should have remained upon that ship at least two or three hours; and though the life-boat did attempt to get to her, and succeeded in getting one or two off, yet after leaving the ship the rope broke, and they did not get to her again; and though they struggled for half an hour, he saw from the opposite shore they never got out. He understood the sea was extremely strong; and the oars broke repeatedly. He did not attribute such a failure to any want of courage in the men, but to the want of system. If all things could be well appointed in the first instance, and the boats could be launched instantly, it would be quite enough. His notion was, if the boat was all ready, and men in order to man her always ready, that great good might arise from such an arrangement. As the boats were required only occasionally, the probability was that no good could be done unless the boat and everything were kept in order. He had a very high opinion of the intentions of the shipowners, and laid no blame upon them. He would just add he saw these men washed off one after another. It seemed shocking these poor men should have been for so long a time amused with the hope of escape, and yet one after another they were washed off and drowned.

Mr. CHAPMAN, M.P., observed that so far as he had seen, the want was not in men to man the boats, for so far from there being any backwardness in men, there was more likely to be a voluntary rush which might produce confusion. Any well organized system, it was very desirable, should be devised and introduced.

The COMMISSIONERS said there should be a committee appointed, who would take charge of the boat, have men appointed for it who should be duly exercised, and have the boat always in readiness and in the best state possible. The ropes, which should be of the best possible manufacture, should be changed once a year. And he hoped, if a committee were appointed, they would be ready at all times to inspect personally the state of the boat; for when lives were lost, as had just been described, it was very bad indeed. There should be one proper person in charge of her, who should be under the orders of the committee, and carry out their arrangements.

Mr. MORDEY wished to make a few remarks. He considered a certain number of men should be employed, and always in readiness to man the boat, who should be properly remunerated. This was not done. The men were paid in the most capricious manner. There was no fixed sum, and he had heard complaints amongst the pilots that they never knew what they were to receive; or whether they would receive anything. They did not know what they would receive, or whether they would receive anything at all. It depended upon the caprice of the committee. Many of them said in consequence they would never go into the life-boat again; and no wonder, therefore, if the boats were not properly manned. He contended that a certain number of men ought to be appointed to the boat, who should exercise themselves, so as to be able to handle her. In the case alluded to by Mr. Backhouse, he himself saw the oars of the life-boat broken repeatedly; and the cordage, owing to the damp, was in very bad order. If the cordage was steeped in some preparation it would last a considerably longer period.

Mr. THOS. BROWN observed that the shipowners not only were desirous to have the life-boats in the most efficient state, but had allowed themselves to be deeply taxed to have it so. But still, in connection with this, there was no person in the town (unconnected with shipping) who ever contributed one farthing to the funds. They found a great number of gentlemen ready to complain when an accident occurred; and that the men were badly paid; but they never found them come forward and subscribe to recompense these men more liberally. But this could not be charged against the committee, because they were always mindful to recompense the men with the utmost liberality. No doubt there might be complaints of not being paid, and so on; for men who crowded into the boat without being wanted, and were turned out again, could not expect to be recompensed. As in the case of fires, there were always plenty to assist in putting it out; but as the services of the whole of them were not required, they could not complain at not being paid. But those who did go out in the boat were not illiberally dealt with, for so far as from 16*s*. to 20*s*. were paid per man, and as much as 70*l*. was paid on one occasion. It was said they might have fixed men; but then, if they depended upon these men, they might not always be in attendance; and then there would not be men to man the boats at all; for though there might be numbers present, they would say, "the committee have men appointed, and if we get in we will not be paid;" and the consequence would be they would refuse to go. The committee, therefore, considering this, had thought it best to depend upon those who might come voluntarily forward, and be available upon the spot.

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Mr. BACKHOUSE explained that he had repeatedly inquired whether the life-boat fund was exclusively a shipowners' fund or not, and he had always been answered that it was; that it was wholly in their hands, and that they had always as much money as they required. Therefore it did not appear to be wished, or else he was satisfied there was the greatest disposition felt by others to contribute.

The COMMISSIONERS said they considered the best way was to do as was done in the south of England—enroll a number of men, and, when it was required, let the first ten or twelve men that came of those that were entered upon a certain register, be the first men taken to man the boat. These men should be ensured one guinea every time they went out; and the whole force should be turned out to exercise every month, for which they should receive 2*s* 6*d*. per man; and in the course of their exercises they should test the goodness of their boat, the strength of their oars, and their own strength and skill to manage them in every conceivable method. The boat also should be inspected every year or oftener by an experienced builder, and the old rope should be thrown away every year, and replaced with new. Besides, it was necessary to have a committee of management, who would really do the work themselves, and not trust to subordinates. And as one mode of maintaining a fund to keep up the life-boat establishment, they instanced the case of boats on the southern coast to which they had alluded, which were maintained by subscription from the surrounding gentry.

Mr. THOS. BROWN proceeded to draw a contrast between the life-boat managers at Shields, and the conduct of those at Sunderland. If the Shields life boat saved the crew of a Sunderland ship, there was a charge made upon them of 20*l*. Whereas there was no charge at Sunderland for saving the men of ships belonging to any place whatever.

Mr. JONASSOHN, with the view of showing that the life-boat committee were actuated by an anxiety for the efficiency of the life-boat, instanced the fact of their subscribing last summer to a premium to be competed for at the Tyne Regatta, by the life-boats of this and the neighbouring ports, with the view of encouraging them and endeavouring to learn them how to manage their boats.

The COMMISSIONERS remarked that nothing could be clearer than that the committee were actuated by the very best intentions, but unfortunately their intentions seemed not to have been properly carried out. They expressed themselves obliged for the information given respecting the mismanagement of the boat by Mr. Wake, Mr. Backhouse, and Mr. Mordey, as they considered it had given rise to a most valuable discussion.

Mr. J. RIDDELL examined.—He said he was the foreman of the harbour works under the engineer, Mr. Murray. He had been employed here for about ten years, and previously six years under Mr. Gibb at Aberdeen, and four years on the Clyde, having thus been employed as a working engineer altogether twenty years. As to the piers, he observed that the old piers had been very poorly built, and a good part of the old pier had bulged before it was taken down. The foundations of the lower pier were six feet below low-water mark; the width between the ends of the two piers, at the entrance of the harbour, was about 400 feet; and the width of each pier about 43 feet 3 inches. When an addition was made to the length of the North Pier, the light-house was removed from what had been the end of the pier to where it now stood without being taken down; it was removed on a railway, and it was considered that the expense was one-half less than it would have been had the lighthouse been taken down and another erected; nor was the use of the light ever lost during the removal, as the gas-pipe was attached to the light and extended as it was moved. Nearly 200 men were employed on the works at the pier.

Next, as to the rocks and shoals in and out of the river, he said there was a rock at the Gill which had been lowered some time ago, so that the water had been deepened to about twelve feet at low-water mark, but he believed that there was rather less water there now. He did not know any banks or shoals particularly in the river which might be removed. There was a rock at the Narrows beside the Ferry-boat landing—a limestone rock, which was a good deal in the way of the shipping, and he thought could be removed—it might be done by a strong coffer-dam, but a coffer-dam would be very much in the way of the shipping. There was another without the harbour, which run almost in a line with the South pier, and did a great deal of damage to vessels taking the passage unless they were very careful; there would be about two feet less water than on the bar. There would be great difficulty in removing it, but it might be done by a diving-bell; blasting would be had to do. Mr. Joshua Wilson, Mr. Thos. Brown, and others, made various observations, from which it appeared that there were some places within the harbour which were not so deep as at the bar; that dredging did not do so much good to the bar as scouring; that there was a shoal at the North Dock entrance, and that the current of the river was directed so as if possible to sweep away all the shoals. A continued line of sea-frontage along the quays would be very advantageous, but it could not be obtained, owing to the want of proper foundations for the quays. It had at times been dry from the North pier end to the South pier. Mr. Rennie's plan had been followed in widening the piers, but the whole plan of Mr. Rennie had not to this day been followed out, for he had recommended two spurs which had never been done, as the opinion of the shipowners was against Sir John Rennie in this respect, and experience had shown that they were right. Mr. Riddell continued:—They had a double dredging-machine in the river, of 22-horse power, and a single one of 12-horse power; they could not move themselves, but had to be towed; and wrought constantly into the harbour, except perhaps in the winter. They had never been tried at the bar, but they could scarcely do anything there on account of the swell. The bank in front of the quays could not be lowered on account of the shallow foundations of the quays, which, however, had not been improved, though they were very bad some of them, on account of being private property. Since the piers had been carried out, the swell had increased in the river, so that they had been obliged to make a beaching-place; and the gales that had come on since, had shown that the beaching-place had a good effect. The original piers would appear to have been stone up to half tides, and carcasses above it; he did not know of any better way of breaking up a sea than timber piles; he thought it a better plan for breaking the sea to have stone up to half-tides, and piles above upon which the sea could expend itself, than to have the piers all stone. It was here observed by several gentlemen present, that this opinion of Mr. Riddell was at variance with the opinion of several eminent engineers.

Docks were much wanted in Sunderland. There was already one on the north side, the entrance to which however was indifferent, but it would have been a "rare dock" if the entrance had been at the Holme Sand. The best place for a dock at Sunderland was to the south of the harbour, where, he thought, there could be no difficulty in carrying it out. The foundation was limestone rock. It must, he believed, be excavated for the depth of water, but he could not say the exact depth that would have to be excavated. There would not be much difficulty in making a sea wall, to stand against the sea; it would have to be as high as the South Pier, but he could not tell whether it would have to be as solid. The sand seemed to increase there. The bank had given way about 80 feet within the last nine years. The examination concluded by a reference to the depths of water now on the bar as compared with former times; there being not the slightest question that it had been greatly improved. Mr. Joshua Wilson said there were parts of the river shallower than at the bar, but the foreman said he did not know of any except at the entrance at the North Pier. Mr. Wilson, Mr. Thos. Brown, and other shipowners, expressed themselves strongly in favour of a South Dock with a south-eastern outlet, which will allow ships to sail in a north-east wind for London.

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No. 196.

Evidence taken on the 31st Oct., 1845.

Mr. THOMAS CAMPBELL, a pilot, put forward a plan for the protection of the harbour against the sea. He was only sorry so many able engineers, though they had seen the evil he wished to remedy for years, would yet never adopt his plan. He would just lay it before them. There was a ridge of rocks, he had seen it often, and it ran from the North Beacon into nearly the end of the North Pier. There had been much damage done by it; it was the place where Nicholson's ship had been lost, and after that something should have been done. There only wanted a wall to be built upon this rock, to rise above high-water mark, and then they would have a proper protection from the sea, and get ships into Sunderland harbour when they could get neither into Shields nor Hartlepool: and in going out of the harbour they would not get any sea until they got into deep water. This was his protection for the harbour, which if they would carry out, away would go the ships to sea as they could not do now. All that was wanted was the swell of the sea kept out; they had plenty of water. The depth of water was never better than now. Last Sunday ships went out with 15 feet water neap tides.

We cannot do without the dock. The situation of the South Dock was the best situation that could be; it could not be better.

The depth on the bar at low water was 4 feet, and at high spring tides 22 feet.

Mr. JAMES BROWN, who had been a pilot for forty years, examined.—He had also been at sea, having "served his time" in the coal trade; and was well acquainted with the coast between this and Flamborough Head. He said:—

There was a long way more water now on the bar than there was before. About forty years ago, or less than that, vessels of 12 keels, drawing not perhaps above 13 feet water, were obliged to complete their cargoes in the roads; but now vessels of 22 keels could come in, drawing 15 or 15½ feet water; and in these last spring-tides vessels of 18 feet 4 inches might have gone out. It had improved inside the harbour also. He had known when women gathering coals could cross the river at Hardcastle's slip, where now it was deep water. There was also not near so much range (swell) in the river now as before, owing to the taking down of part of the South Pier, and the formation of a beaching-place, so that shipping now lay much more easy, and there was less danger of their breaking adrift.

A dock would not do on the north side. We want a dock on the south side with an entrance to the southward. There were two points which would be best for the entrance and outlet between Crab Hill and the Dove Rock, by which vessels could get to sea at all points of the wind. The intention was, he believed, to carry the piers of the dock out into twelve or thirteen feet of water at low water, and that would go beyond all the small rocks off the beach.

There was once a beacon with a bell on Hendon rock, which had been washed away. The coast was well lighted. He would have no difficulty in running a ship into the harbour if there was water on the bar, and he would sooner bring a ship into Sunderland Harbour than into either the Tyne or Hartlepool. The bar at Sunderland was better than the bar at the mouth of the Tyne, because Sunderland bar was an extremely narrow shelving bar, whereas, the bar at Tynemouth was a very wide bar, perhaps a quarter of a mile broad, and there was so much broken water to cross over. The sea also breaks much heavier at the Tyne-bar than at Sunderland, which was to some extent protected from the north-east winds by Souter Point, and many vessels came to Sunderland which had been bound for the Tyne, but dared not venture into the port.

Mr. JONASSOHN said—Would it not be desirable the Commissioners should have some evidence of the disadvantage under which the ship-owners labour in taking in their loading here, and that shipping at low water lay aground, by which immense damage was annually sustained. He believed Mr. Brown would bear him out when he said that, upon the most moderate calculation, it was supposed the insurance companies suffered to the amount of at least 80,000*l.* per annum by this alone. They had a case in point only yesterday, when a ship which had taken in her cargo at the Earl of Durham's Drops was so much injured by taking the ground at low water that the master was obliged to set all hands to the pumps as she came down to the river, where she was now lying, and very likely would have to discharge and repair. Such occurrences as this were not solitary, but happened often. To show the great disadvantage under which they laboured compared with other ports, he need only say that ships of the first class would not take the harbour here but went round to the Tyne, so that this port suffered very considerably. There were ships of a large build, which, to keep up their bottoms, would not be chartered here with any of them unless they loaded them in the Tyne. This showed the necessity of docks.

Mr. GEO. SPARKS said he had a ship of 25 keels, which he was obliged to take away with a load of 21 keels, as that was all the underwriters would allow, on account of the bar and on account of the river. The river was bad. In the principal part of the Bishopwearmouth side there was only one or two places where vessels could lie afloat at low water. If the entrance was at the Dove-rock, it would take ships into 21 feet water. But the Coble-road was the best outlet that could be made, but this was not according to the plan proposed. If the tow-ropes were to break they would have more sea-room by the Coble-road. They would also sail out better by it in every state of the wind.

Mr. THOS. BROWN was of opinion the dues would not amount to so much as was now paid upon insurance. Frequently also ships were detained in the harbour from north-east winds; whereas, as soon as they were laden, they would be able to go to sea by the dock.

Mr. LAING mentioned cases in which from the want of water in the harbour his ships of a large class had to go elsewhere instead of coming to this port.

The following account of the number of vessels which arrived at and sailed from this port in the years 1825, 1830, 1835, 1840, and 1845 respectively, distinguishing those employed in the foreign and coasting trade, has been furnished to the Commission by Mr. Lloyd of the Customs:—

YEAR.	INWARDS.		OUTWARDS.	
	Foreign Trade.	Coasting Trade	Foreign Trade.	Coasting Trade.
1825	164	8480	326	8346
1830	339	7352	778	6963
1835	482	5787	968	5355
1840	1478	4999	2211	4328
1845	1436	5330	1924	5112

J. A. LLOYD, *Collector.*
W. J. STEWART, *Comptroller.*

Custom House, 27th January, 1846.

[Mr. MURRAY, C. E., *being absent from Sunderland at the time of the inquiry, sent the following statement.*]

Sunderland is situated in a flat bay on the eastern coast of England, and at the embouchure of the River Wear. It is exposed to the winds blowing from N. E. by N. to S. S. E., or eleven points of the compass. E. N. E. to E. S. E. winds produce the heaviest seas. The river is navigable from its mouth for a distance of nine miles upward.

The estuary of the river has been confined by piers of masonry. It has a bar at its mouth, a short distance from the pier heads, having about four feet of water upon it at low water of ordinary spring tides. The narrowest width between the piers is 320 feet,; the direction seaward midway between the

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piers is nearly due east, and this is at present the navigable channel. The rise of an ordinary spring tide is 14 feet 6 inches, but an equinoctial spring tide rises 3 feet 9 inches higher; neap tides rise 6 feet, high water of such a tide being 3 feet 6 inches below the 14 feet 6 inches mark on the tide index. The ebb stream rarely exceeds two miles an hour.

The conservators of the River Wear, Port and Haven of Sunderland, are a numerous body of the most influential landed proprietors, coal-owners, ship-owners and merchants, in the town and neighbourhood, and they have been entrusted with their important charge, by several Acts of Parliament, since the time of George I. They have for many years paid particular attention to improve the channel and to deepen the bar. They consulted that eminent engineer, the late Mr. Rennie, and his plans were to prolong the piers with solid masonry into deeper water. The north pier is now completed to the full extent, and the south pier has also been lengthened, but it is considered advisable to let it remain as it now is, to see the result of altering the other pier. The most beneficial effects have been produced by the adoption of these plans; the channel has been straightened and deepened by dredging, and the bar has been lowered and kept in a stationary position by the judicious direction of the piers.

To lessen the swell which entered the piers during easterly winds, a considerable portion of the south pier has been taken down, and with the materials a pier is now being constructed in a different direction, so as to leave a large inlet or bay, upon which the waves are tranquillized. A similar receptacle, but of larger extent, called the Potato Garth, has long existed, and proved beneficial on the north side.

There are two dredging machines employed in deepening the river. One of them has two ladders, each worked by steam-engines of 12-horse power. The other dredging machine has one ladder, and is worked by a steam-engine of 14-horse power. The excavated soil is deposited into hopper vessels, which are towed to sea by a steam-tug, and the soil is there deposited in five fathoms water. The quantity dredged varies from 100,000 to 150,000 tons per annum, and the sum expended in this department amounts annually on an average to 2500l.

Nearly the whole trade of the port is transacted in the tideway of the river, from near its mouth for a distance of two miles upward. At the beginning of the present century, the average burthen of vessels belonging to the port was about 150 tons; a large ship being then reckoned 250 tons burthen, and which, after taking in two-thirds of her cargo in the harbour, had to cross the bar on account of the deficiency of water, and take in the remainder while lying at anchor in the roads, from flat-bottomed keels. Even a few years ago, it was only at the top of the spring tides when there was sufficient water in the channel, and on the bar, to allow vessels of the ordinary size to leave the harbour, and if the weather happened at that time to be boisterous in consequence of easterly gales, the spring tides passed over, and the vessels had to wait till the next. Numerous ships have thus been detained, and the harbour has been crowded to a very great extent, causing many of them to take the ground in their loaded state, in very awkward positions, by which they have received considerable injury.

The rapid increase of trade and the improvement of the port have caused many ships to frequent it, ill adapted to withstand the strains to which they are necessarily subjected. The vessels now belonging to the port are chiefly of a large class, and of such a description as to make it extremely probable, without further improvement, that they will sustain great damage by straining and lying badly when aground.

The formation of wet docks has therefore for many years past been a desideratum. A dock of about eight acres in extent, with a small tidal basin attached, communicating with the River Wear near its mouth, has been executed by a private company on the north side of the river, on the low ground northward of the north pier.

A company has lately been formed for the purpose of obtaining the sanction of Parliament during the present Session, to make a dock along the sea shore in front of the Town Moor, of upwards of 34 acres of water, and capable of accommodating 350 vessels always afloat. A principal feature of the project is a sea tide basin, and a southern outlet into Hendon Bay. By means of it, Sunderland would become the first port, as to depth of water at its entrance, between the Humber and the Firth of Forth. The prevailing winds, when it is most desirable for vessels to leave the port, are those from the northern and western points; consequently vessels of the largest burthen could then take their full cargoes from the dock, and proceed to sea from an outlet pointing southward into an offing well adapted for the trade of the port.

No. 197.

Mr. WALKER's *Report on Plan for proposed Docks at Sunderland.*

No. 197.

Walker's Report on Plan for proposed Docks at Sunderland.

23, *Great George Street,*
3rd January, 1846.

The want of a dock or some other good accommodation for shipping in Sunderland has long been felt, and various plans have been proposed, one so far back as 1794, by Mr. Dodd, another in 1807 by Mr. Jessop, another in 1832 by me, when Mr. George Rennie also reported his opinion; nothing however was done until 1835, when a dock of six acres with an entrance basin was begun by Mr. Brunel on the Monkwearmouth or north side, and finished in 1838.—But little coal trade has been done in this dock, the collieries being chiefly on the south side of the River Wear, but it has been useful for the reception and fitting out of large new ships in the foreign trade, and, during the winter months, a great many vessels have been laid up in it. In 1844 Mr. Murray, the engineer to the Harbour and River Commissioners, and now one of the engineers to the proposed Dock Company, suggested a plan for the improvement of the harbour on which I reported, but there were objections which caused the design to be dropped, thus the river and the Monkwearmouth Dock form the whole of the shipping accommodation for the Port of Sunderland, in which there are sometimes 300 coal laden vessels. The harbour is notoriously shallow, so that all the laden ships ground in it—the bottom is hard and irregular—ships in the harbour are also subject to heavy land floods and ice, by which last cause 40,000l. of damage is stated to have been done in one day.*

The evidence states that every vessel which takes cargo in Sunderland is more or less damaged, that almost every vessel which comes to Sunderland for a number of voyages, has some of her timbers broken—that very few of the large coppered ships for the Mediterranean or other foreign parts take cargo at Sunderland, as the ship or the copper almost always gets damaged, as but few of the berths in the harbour have so much as 9 feet and some of them only 4 feet at low water; that sometimes the whole trade of the port is at a stand with two to three hundred laden vessels in it, owing to a want of water upon the bar; that the owners of large ships in the foreign trade cannot, although they belong to the Port of Sunderland, bring their ships there for coal cargo, but send them to the Tyne (where there is 2 feet more water), and elsewhere that this export trade of coal for the supply of steamers and otherwise is rapidly increasing, so that the rise is now more felt than formerly; that, if there were water and safety, ships for the East and West Indies would go to Sunderland as the best coal for steam vessels is from pits that are round Sunderland, which for the above cause is not supplied for export to the extent it would

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* This was during the winter of 1841.

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therwise be; and that for these reasons the trade of the Wear has been nearly stationary for some time, while that of other ports has been rapidly increasing.

Strong illustrations of all these evils were given to me on my late, as well as on my former visit; but I think it unnecessary to extend the report by detailing them, even if their lordships were not aware of the general facts, which I presume they are, and that a dock, in which vessels are always kept afloat, and are at one level secure within gates, has great advantages over almost any Tidal Harbour and particularly so very bad a harbour as I have now described. I would not from this have it to be concluded that the harbour of Sunderland is not capable of improvement; I think the contrary, but to whatever extent this may be carried, it will always be inferior to the dock which will be used generally except on cases where the present railways and staiths some of which have been laid and erected at great expense communicate with the harbour.

To relieve the harbour of its occasional crowds, thus giving better room for those that remain will of itself be of great advantage.

On principle therefore there is every public argument in favour of the dock scheme, and none that I can see against it.

The new dock is proposed to be formed by a dock company of which Mr. Hudson, the member of the town, is Chairman. His wealth and influence are additional guarantees that the scheme will be carried through. I have not gone at all into an examination of the estimate of costs which Mr. Murray states to be 200,000*l*. exclusive of purchases and parliamentary expenses (which are likely to be small) because if their lordships think that any security should be given for the completion of the work in case of cost exceeding expectation, there would, I apprehend, be no difficulty in getting it. The plans have been prepared by Mr. Robert Stephenson (the eminent engineer) and Mr. Murray.

The latter gentleman has been engineer to the River and Harbour Trust for 15 years,* during which time the erection of the new north pier—the removal of the lighthouse and other interesting works have been successfully executed by him.

At high water the sea washes the foot of a clay bank, which is about 35 feet high, and extends from the river southward for the length of the town.

Between the top of this bank and the town is the Town Moor; the clay bank, when washed away by the tide, exposes the surface of a limestone rock which inclines upwards from low water and is in width from four to six hundred yards.

Out of the heretofore valueless rock formation, the dock and basins are to be excavated, the excavations being applied to raise the space round the dock, &c., to the proper level for quays.

The form of the docks, its basins and approaches, will be best understood from the plan. The north entrance is out of the River Wear between the inner end of the south pier, and the town through two passages, one of which points to the north-eastward or seaward and is proposed to be 45 feet wide—the other, which points up the stream, is eighty feet wide. These form open passages into an entrance basin of two acres and a half, between which basin and the dock are two inner passages of sixty and forty-five feet wide, with gates pointing inwards or towards the dock. The dock is twenty-seven acres and a half area—therefore capable, at ten ships per acre, of receiving two hundred and seventy-five ships. The Committee calculate on three-hundred and fifty of from two hundred to three hundred tons.

The lift of a spring-tide being only 14 feet 6 inches, the dock is to be 6 feet under low water, giving 20 feet 6 inches water in the dock on a spring, and 17 feet on a neap tide. The above depths can be maintained in the dock, but the depth at the bar at the harbour mouth is 2 feet less, so that with the "send" of sea during a north-east gale, a vessel drawing more than 14 feet cannot venture over the bar with safety. To have the dock so much deeper than the approach to it, would be of little use; and yet from the great draught of ships from foreign ports, it would be very advisable to have not less than 17 feet at neap, and 20 at spring tides; the engineers propose to accomplish this by sending laden vessels chiefly out at the south, and through a tidal basin, of 4½ acres with two openings, one having gates of 60 feet, and the other of 45 feet between the dock and it, and other similar gates between the basin and the outer entrance. The outer entrance, or rather exit, points south south-east nearly,† and is to be formed by means of rough breakwaters, one on the east tide, nearly parallel with the entrance, and the other on the west side, nearly square with it. This southern passage is proposed to be as deep as the dock, and to be kept to that level by dredging and scouring. This very important feature of the plan (the southern passage) is, so far as I remember, new, and, if it can be effected as proposed, will be a great convenience, by giving laden ships 2 to 4 feet more water than can at present be depended on, starting them in the right direction for the south when the wind is fair; also leaving the Wear or harbour entrance clear for the present harbour, and the entrance of light ships into the docks.

As thus neither the dock nor the works at the south end interfere with the river, it is not within my province to be very particular in the detail of them. They are on a scale which consists with the character of Sunderland, now the fourth port in the kingdom for the amount of shipping, and they will tend to raise it higher. Various opinions were given as to the position of the southern passage, and alterations were suggested on account of the entrance as it is drawn being too near the shore; but as its removal outwards, or pointing it more to the eastward, would open it to a heavy sea from which the entrance, even as now proposed, will not be free, and as vessels can in all cases where there is the least danger have the aid of the steam-tug, I should not feel justified without a more detailed inquiry in suggesting an alteration. The Hendon Rock, which is a mile and a half off, with 6 feet over it at low water, will require to be beaconed or buoyed.

The northern entrance will interfere with the passage up the harbour as the river is narrow, and as Mr. Murray thinks that the ships will generally enter by the western passage (that which points upwards), they must swing before entering, and will cause the removal of the lower tier in the harbour; although ships in going up the harbour hug the north shore opposite the point where the entrance of the dock is proposed, it will, I think, be requisite to widen the river here, as swinging in a strong tide-way requires considerable room. The Harbour and River Commissioners may expect to have a clause in the Act for this purpose. Light ships entering by the eastern passage will not require to be swung, and will be less in the way, both in going in and out.

The rate upon coal vessels is proposed to be three-halfpence per ton register, or 25*s*. for a ship of 200 tons, which is less than the average damage which each ship takes at each voyage by grounding.

Mr. Murray stated that the basin is to be kept clear by dredging, so that sand will not be scoured into the river, and that there will be no objection to a clause in the bill to prevent the scouring, and

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* Sir John Rennie was consulting engineer during 6 of the 15 years.

† The bearings are all by compass.

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to maintain the level of the river opposite and near to the entrance. The Wearmouth Dock Act contains some stringent clauses of control over that river and Harbour Commissioners over that Dock Company, which with modifications will be useful in the proposed Dock Act; but I do not find any clause giving the Commissioners or their harbour-masters the absolute management of vessels intending to enter the dock, until they shall be completely out of the river, or of vessels leaving the dock after they approach the river.

I submit that the appointment and continuance of the officers and men who have this work to do should be with the Commissioners, although the charge be ultimately borne by the Dock Company.

It is very satisfactory to me, after the remarks I felt called upon to make on Mr. Murray's plan for improving the harbour, to have so much to approve and so little to object to in the present design. Neither he, nor those who at the time agreed in opinion with him are, I hope, now sorry that the execution of the former measure was prevented through the interference of their Lordships.

My opinion upon the whole is—

1st. That their Lordships should consent to the dock as proposed.

2nd. That the Bill should contain clauses for the following purposes, *viz.*,—

For preventing obstructions in the river during the execution of the works, and afterwards.

For widening the river opposite the proposed northern entrance, so that the present facility for ships passing up or down the river be not interfered with.

For preventing scouring through the sluices of the north entrance.

For giving the river Commissioners the appointment and power of discharging the Dock Company's officers, who are to take ships from the river into the northern basin and the reverse; the Commissioners having the absolute direction and control of the ships in the river, and the times of their being removed into the river.

For obliging the Dock Company to keep the river opposite their entrances to the full depth of the other part of the channel, which are beyond the influence of the entrance.

For securing the completion of the works, according to the present design, any alterations to be approved before being made.

For fixing a beacon or buoy on Hendon Rock, and elsewhere, if required for the safety of shipping.

For erecting convenient bridges over the entrances, so that the passage between the town and the south pier may not be interrupted beyond what is necessary.

I have, &c.,

JAMES WALKER.

The Secretary of the Admiralty,
&c. &c. &c.

HARTLEPOOL.

No. 198.

Evidence taken on the 30th Oct., 1845.

No. 198.

PORT OF HARTLEPOOL.

Examining Commissioners—AARON CHAPMAN, Esq., M. P., and Captain WASHINGTON, R. N.

Present:—The Mayor (THOMAS ROWELL, Esq.), ROWLAND BURDON, Esq., THOS. WOOD, Esq., and M. H. CHAYTOR, Esq., Directors of the Hartlepool Dock and Railway Company; R. WARD JACKSON, Esq., Solicitor to the Hartlepool West Harbour and Dock Company; ROBERT RAYSON, Esq.; CUTHBERT WIGHAM, Esq.; &c., &c.

Mr. WM. DAVISON, secretary to the Port and Pier Commission, examined.—He stated that he had been secretary since 1832, and produced the different Acts of Parliament by which the Commission exercised its powers. There are now 21 Commissioners, all of whom are named in the last Act; the vacancies will be filled up by the remaining Commissioners; seven form a quorum; a meeting has not been held since the last Act was passed. The Commissioners have power to borrow 16,000*l.*, which sum has been borrowed, 1200*l.* at 5 per cent. and the remainder at 4 per cent. [It appeared from the remarks of different gentlemen that there is a doubt whether the act compels the Commissioners to meet at all, but Mr. Burdon stated that they intend to meet on the 13th November.] The officers of the Hartlepool Dock and Railway Company have hitherto been the acting officers of the port. The income derived by the Commissioners from port charges amounts to upward of 2000*l.* per year, which has been expended in improving the harbour and paying the interest of borrowed money. The parliamentary and legal expenses had been during the last few years about 1100*l.* [Mr. Jackson said that 900*l* of the public money had been expended in opposing the West Harbour and Dock Bill, and Mr. Wood replied it was done by the Commissioners because they were advised by their engineers that the West Dock would injure the harbour.] 11,450*l.* has been expended in dredging and otherwise improving the port; the dredger cost 7000*l.* or 8000*l.* The old Dock Company used the dredger at one time. The whole of the salaries of port officers is 50*l.* per year; last year they amounted to 100*l.*, in consequence of a present made to Mr. Finlay for extra superintendence. He had not received any written complaints. The Commissioners held adjourned and special meetings; their accounts are not open to the public. The revenue of the port previous to the formation of the dock was on an average of six years 30*l.* per year, since then it has gradually increased; the income in 1844 was 1823*l.* 8*s.* 8*d.*, and this year it will be larger. From January to September in the present year there were from nine hundred thousand to a million tons of coals shipped at the port. There is a toll levied by the Corporation, which last year amounted to 358*l.* 3*s.* 8*d.*, it is expended in keeping up the town or sea wall. [Mr. CUTHBERT said there was not 30*l.* per year expended in repairing this wall.] This toll is levied by prescription.

THOMAS WOOD, Esq., then read the following statement which he had prepared:—I was appointed a Commissioner of the Pier and Port of Hartlepool in 1831, under the original Act of 1813; at this time myself and others contemplated the construction of docks at Hartlepool, and in the following year, 1832, an Act was applied for and obtained for that purpose. Simultaneously with this an amended Act was applied for by the Pier and Port Commissioners. At this time the pier was in ruins, only a small portion of each end being in existence, and the present outer harbour of the Commissioners, as well as the slake and inner harbour, now the tide harbour, and Victoria Dock of the dock company, were wrecked up with sand, and so that there was not more than 8 to 9 feet water in the deepest part at spring tides. From the excavations of the Dock Company the deposit appears to have varied from 12 to 15 feet in thickness, as several relics, such as anchors, mooring stones, keel of a vessel, &c., were found about 12 feet below the then surface of the slake and harbour; a bed of peat, with trunks of trees, was generally found at that depth; below this was a strong hard clay mixed with stones, which, with some slight exceptions, forms the bottom of the present docks. By the Act of 1813 (53 Geo. III. c. 35), the Commissioners were authorised to charge certain tolls on the houses in Hartlepool, a tax on fishing cobles, and other dues. By the amended Act of 1832 (2 and 3 Wm. IV. c. 68) the tax on houses and cobles was repealed; and as there was no trade to the place the trust was without revenue from 1832 to 1835, when the docks were opened. Previously to 1832 the revenue had been about 60*l.* a-year. It was during this period

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that the pier was repaired, the dredger built, and the other improvements in the entrance were made. As the Commissioners had no revenue, no one would lend them money, and the Dock Company was therefore compelled to advance funds for these works. The advance thus made amounted to nearly 8000*l.*, the sum the Commissioners were then authorised to raise. When the Dock Company applied to the Exchequer Bill Loan Commissioners for a loan in 1834-5, the first condition that they made was, that the Commissioners should repay them the sum advanced for their works. This was accomplished by witness and other individuals giving their personal security for the Commissioners' loan to two gentlemen who advanced the money. The channel from the coffer-dam to the pier was first attempted to be made by dredging: very little progress was made until the water was let into the docks, then excavated, where it was confined between a small opening in the coffer-dam, and acted as a powerful sluice. By this means in a very few days a better channel was made than had been previously done by several months' dredging. The coffer-dam was then cut through and the sluices applied, which in a very short time made a channel for vessels of 10 to 12 feet water. As it was of great importance to deepen this channel the sluices were called into operation before the masonry of the aprons was set; and the consequence was, in the latter part of 1835, the aprons were torn up and the sluicing suspended in consequence. From this time to the middle of 1836 the sluicing was stopped by the repairs in progress at the sluice aprons, and the channel became gradually worse, and more deflected to the west, by the increase of the spit or sand at the south-east of the pier. This was immediately remedied by recurrence to the sluices, and gradual improvement in the entrance was made until 1839, when it was again necessary to suspend sluicing owing to the works going on at the Loch, between the tide harbour and the slake. It fortunately happens that at this time a record of this silting up, or deposit in the channel, was kept by Captain Slater, R.N., the officer surveying the coast at that time, who, by a report, dated May 24, 1840, states "that in consequence of certain alterations being made in the works adjacent to the sluices, the tidal water had at times been kept altogether out of the slake. Under these circumstances, therefore, I might reasonably expect that the state of the channel from the coffer-dam to the sea would be in the worst state possible." On each of the plans which accompany this report, a smaller space, inclosed by a red line, has been allotted for the insertion of soundings, in order to make a comparison of the mean depth under different circumstances, thus the mean depth of water in the cut, and off the entrance, was found to be as follows:—

IN THE CUT.	Feet.	OFF THE ENTRANCE.	Feet.
In November, 1838	4¼	In November, 1838	3½
In May, 1844, before sluicing	3¾	In May, 1840, before sluicing	3
In May, 1844, after sluicing	4	In May, 1840, after sluicing	3¼

Captain SLATER entertained the opinion that the tide alone ebbing and flowing from and into the slake would produce sufficient scour to keep the channel clear. It is obvious, that in this respect, this officer was mistaken, as the bottom of the slake is above 12 feet higher than the bottom of the channel, so that when the slake water has ebbed off, there is still 12 to 14 feet water there, a depth at which it is notorious no scouring can take place.

The sluices at the north-west end of the tide harbour have been constructed and worked by the Dock Company at their own cost; and in 1837 an amended Act was obtained by which the expense of the coffer-dam was thrown upon the Dock Company, it having been a point of doubt. This Act also authorised the Commissioners to borrow a further sum of 8000*l.*, and it increased the tolls authorised to be taken by the Act of 1832. The report of Mr. John Murray, the engineer of the Commissioners of the river Wear, will furnish some further evidence of the value of sluicing to the entrance of the Hartlepool harbour, and it is a fact which may be ascertained by any one, that there is a continual tendency to make deposits in the water of this bay. It has been seen that in the course of years, 12 to 14 feet of deposit had been made over the site of the present docks. Since the erection of the jetty a deposit of 5 to 10 feet has taken place between that work and the coffer-dam. It is obvious to a casual observer that the slake is gradually filling up, and the deposits in the channel unnoticed by Captain Slater, all tend to show that if the place was left to its natural aid only it would become what it was before the docks were begun. This natural tendency is counteracted by the sluicing, which drives out into deep water the obstructions which place themselves in the sailing channel. In the session of Parliament in 1843, a company called the West Dock Company obtained an Act to make a dock near Stratton, on the west side of the bay. The Commissioners, after taking the opinions of Mr. Murray and Mr. Rastrick, as to the effect which this dock was likely to produce upon their harbour and sailing channel, opposed the project in Parliament, because they were advised that no channel could be made and preserved from this dock without piers lengthened into deep water in the bay, and sluicing down the channel thus made, which they were of opinion would not only interfere with the course of vessels entering the present docks in a north-by-west wind, but would also by sluicing cause great deposits at the entrance of the present harbour. The report of Mr. Rendel, requiring their channel to be kept open by dredging, shows that he had similar suspicions; and the legislature further restricted them from sluicing by clauses inserted in their Act. Since this restriction was imposed upon them to prevent sluicing—against which they strongly contended—they have been incessant in their endeavours to raise an outcry against the sluicing of the original Dock Company. The revenue of the Commissioners, now nearly 2000*l.* a-year, is derived entirely from the trade of the Dock and Railway Company. The port under their management has gradually been improved, till it now is acknowledged to be the safest and most easily accessible for large vessels on the east coast, and its success has almost necessitated the formation of docks at Sunderland and Shields to preserve their trade.

Mr. STEPHEN ROBINSON was next examined.—He said that he is engineer to the Hartlepool Dock and Railway Company, and has acted as engineer of the harbour since Mr. Finlay left, which was in 1842 or 1843. He spoke to the state of Hartlepool before and after the formation of the present dock, showing its present great superiority. The sluices of the Hartlepool Dock are about 1000 yards from the bar; their distance he considered immaterial, as their power depends upon the body of water and its velocity. The channel was made by dredging and sluicing. Without sluices he believed the channel would become a level surface again. The width of the lock gates is 44 feet, the area of the dock 20 acres at high water; the purpose of the sloping beach is for the convenience of landing boats and timber; witness would say that it would be better if these were vertical walls. There are 16 "drops," and about 40 keels of coals could be supplied daily by one drop. He believed that 5000 tons of coals had been loaded in one day of 14 hours. The dock is in good repair. More coals than 5000 tons could be shipped in a day if brought down; there are about 40 kinds of coal shipped. Up to this time there has been sufficient accommodation in the dock for the vessels which have come; as many as 100 vessels had come into the dock at once for refuge. He had seen about 400 vessels at one time in the dock. He had never seen the docks so full that other vessels could not come in.

Mr. JACKSON remarked that the rocks near the Heugh, which formed the natural headland to the bay, had been removed for the purpose of forming the old docks, and had thereby seriously injured the port. The Port and Pier Commission had been hitherto, in fact, the same body as the old Dock Company; and as the procuring of stone thus easily served their own private interest, they did not interfere to prevent the removal of the rocks.

Mr. WOOD said this had been done by the Duke of Cleveland, but the practice had lately been discontinued in consequence of remonstrances made to the noble duke on the subject. The Port and Pier Commissioners had no control.

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Mr. JACKSON also remarked on ballast having been thrown over the cliff to the north by the Dock and Railway Company, and had been washed into the bay, which Mr. Wood denied had been done by that Company.

Mr. RAYSON remarked that when in Parliament before the committee last session, on the Pier and Port Bill, Mr. Burdon, one of the Hartlepool Dock and Railway Company, or his representative, stated to the committee that Sir John Macneill was ready to come forward and say that no improvement was needed in the port.—Mr. BURDON replied that he had been misunderstood; what he said was, that Sir John Macneill stated that 50,000*l.*, the sum mentioned, was not required for the improvement of the port.

Mr. JACKSON said he was anxious it should be understood that he had made his observations not as matter of complaint against any party, but in order that all parties may co-operate for the benefit of the port, and the improvement of the bay.

Mr. RAYSON said he was one of the Port and Pier Commissioners, and he was also concerned in the West Harbour and Dock; he knew there was great difference of opinion among the Commissioners as to the measures which would be advantageous to the port. For instance, some said a pier out to the Heugh would do good, others said that it would silt up the harbour. He mentioned this for the purpose of showing that there is such a difference of opinion as requires a controlling power to be vested in the Admiralty. There were now two companies and docks, and it was of the greatest importance that the harbour and bay should be preserved unimpaired.

Mr. JACKSON was particularly desirous of impressing upon the minds of the Commissioners that as there are now two Dock Companies, it is not likely that they will ever agree on any plan for improving the port. An act of Parliament had been lately obtained for the express purpose of keeping the commission out of private interests. Only four individuals were appointed, who were members of the two Dock Companies; other thirteen indifferent persons had been appointed. These were no doubt highly respectable gentlemen, but they are not interested in the port, and some of them live 30 or 40 miles off, so that still the business will devolve upon the gentlemen connected with the two docks. He thought it was obvious that the public interest should be more strongly represented by persons competent to control private companies. He and the two gentlemen associated with him as Admiralty Commissioners under the former Act were extremely desirous that the Commission should be placed entirely in the hands of the Admiralty; this was objected to by parties on the other side, and hence the Bill had passed in its present state, which had proved to be comparatively useless by the fact that although the Bill was passed in May or June, there had not yet been even a single meeting of the commissioners held. He mentioned this in order that (if possible) something might still be done for the purpose of creating greater control over the improper influence of private interests.

MARK BULMER, a ship-captain; Captain PRENEY, of Lynn; WILLIAM BARLETSON, harbour-master; and MATTHEW HORSLEY, a pilot, were then examined at great length as to the past and present state of the harbour and bay. It appeared from the evidence of the latter that the pilots are appointed by the Trinity-house of Newcastle on the recommendation of Mr. Vollum, sen.

Mr. JACKSON remarked, that as there would now shortly be a new harbour and dock, he thought it important that the recommendation of pilots, instead of being in the hands of Mr. Vollum, who is a Director of the Hartlepool Dock and Railway Company, should be transferred to the public Port and Pier Commission.

Mr. VOLLUM replied, that he always acted in accordance with the recommendation of shipowners, and that he never allowed his connexion with any private Company to sway him in the appointment of pilots.

Mr. JACKSON then explained the steps that are now being taken in the formation of the Hartlepool West Harbour and Dock, and the contemplated additional docks and extension and enlargement of the West harbour. He said—We are carrying our piers out in the mode approved by the Admiralty. Mr. Simpson is our engineer: Mr. David Bremner is the resident engineer. The piers will go out to low-water mark at neap tides. The size of the dock will be seven acres and a half, with quay walls on every side. There is a railway to it, the Stockton and Hartlepool, which will be connected by the Leeds and Thirsk with the Leeds and Manchester, from which we anticipate a great increase of traffic. We have also recommended the extension of the railway round the slake to the old dock and town of Hartlepool. The coal which will be shipped in the West Dock comes from a different district to that which is shipped in the old dock. The Clarence Railway is under lease to the Stockton and Hartlepool Company, and our coals have been shipped in the Tees, owing to not having sufficient accommodation and an independent place of shipment at Hartlepool. We have shipped 400,000 tons by the Clarence Railway in the last year, so that we have a good prospect for the new dock. [Mr Jackson here handed to the Commissioners a copy of the last Annual Report of the West Harbour and Dock Company.] We have an immense quantity of land which may be occupied by separate docks for merchandize and steamers. We contemplate an extension of the piers upwards of 300 yards, into ten feet depth of water at neap tides. We wish the Admiralty to have a controlling power in the Pier and Port Commission, in order that we may not have to ask a competing Company to allow us to lengthen the piers. The Port Act requires that no work shall be done without the consent of the Commissioners. The channel will be kept open by dredging; we never contemplated sluicing, for all the opinions which we received from competent persons convinced us that sluicing is not necessary in the bay of Hartlepool. An estimate was given in to a Committee of the House of Commons of what the annual expense of dredging would be, and it was stated that 300*l.* per would be ample. The difference between the position of the Hartlepool Dock and Railway and the West Harbour and Dock Companies is this—the latter have their own harbour piers, and though they erect and maintain them, they are content to pay the Port and Pier Commissioners the ordinary dues for the general benefit of the port.

Mr. WOOD remarked that the west harbour would be as much within the jurisdiction of the Port and Pier Commission as any other part of the port.

Mr. JACKSON replied that in his opinion this fact spoke volumes. The circumstance that they were dependent on the Port and Pier Commissioners for a harbour, although they had obtained an Act of Parliament to construct it, sufficiently justified the course which he had pursued in endeavouring to establish that the Port of Hartlepool shall be made independent.

Mr. BREMNER, the engineer, was next examined. After stating his experience at various places, he said that during the twelve months he had been engaged at the West Dock he had made various observations; he had seen the peat cut away from the channel and laid on the beach, and the muscles from the slake carried out by the scour and driven on the beach. He had heard the fishermen who were best acquainted with the roadstead speak of this fact. He did not anticipate any difficulty in carrying out the works of the new company; they had good foundations and substantial piers.

The COMMISSIONERS asked several fishermen who were standing around them if the slake was filling up. —Some replied no, and others yes.

RICHARD COULSON, a fisherman, was examined.—He said he had been acquainted with the port 40 years, and had been in the habit of trawling in the bay. Formerly they had blue clay with a rind of sand upon it, but since the old docks were begun, in a storm with the sea tremendously heavy, the clay is so good that he had seen a windlass pulled away by it. That was in the regular roadstead, and S. and by E.

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of the bar, under the lee of the headland. The fishermen could not now trawl, owing to the slush and peat and things of that kind.

Some other fisherman complained in strong terms of the mischief which had been done to the bay, and said that owing to the sluicing they were deprived of a living for themselves and their children. One man said it had been pounds out of his way in the trawling season, for immediately after sluicing they cannot trawl at all; and another named Cuthbert Pounder mentioned one occasion when his nets had been spoiled.

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No. 199.
Macneill on the State of the Harbour.

SIR JOHN MACNEILL'S *Report on the state of the Hartlepool Harbour.*

Nov., 1845.

HAVING been requested by the Commissioners of the Port and Harbour of Hartlepool to report on the general state of the harbour, as to the best means of improving it, and also on the best place for the erection of a lighthouse, I proceeded there as soon as my other engagements would permit, and made such preliminary observations and inquiries as I considered necessary, previous to sending down assistants to make detailed and accurate surveys. During my stay at Hartlepool three situations were pointed out for a lighthouse; 1st, on the top or headland; the 2nd, on the rocks below it; and the 3rd, on the extremity of a pier proposed to be thrown out seaward, from the extremity of the present pier, and at right angles to it.

The light would, it was supposed, serve the double purpose of a harbour and coast-light, and make that now kept at the end of the pier unnecessary.

This last plan, of course, involved the building of a pier, but even if this should be determined on, the propriety of erecting such a lighthouse on its extremity might still be questionable.

The objections to it are, first, the great height which would be required in order to be seen at sea over the Heugh, and consequent cost of erection.

Second, the vessels seeing it from the north and N.E., over the Heugh, might approach too near the rocks in that direction, or near the point of the Heugh.

The rocks at the foot of the Heugh would be a much better situation for it as regards the coast, but its erection there would cost a great deal, and the harbour-light at the pier-head must still be continued.

There is also the objection that it adds another light to the great number already existing along the coast, and might, under certain circumstances, be mistaken for Seaham.

These latter objections apply also to the erection of a lighthouse on the Heugh, where it is also thought that there is a danger of the place on which it would be built being carried away, as the sea has lately made rapid inroads on the cliff.

I do not myself attribute much weight to this objection, as I have no doubt that the lighthouse might be placed far enough back, and means adopted to prevent the falling of the cliff, and the cost of erection would be very much less.

On the whole, if the object be a coast-light, I should recommend the top of the Heugh as the proper place for it.

If the object be to enable vessels to make the harbour, the present situation, with an improved light, might be amply sufficient.

The present light is red, but is not sufficiently powerful to be seen at any great distance, particularly in misty weather. If it were brighter it might be seen far enough, in any state of the weather, for vessels wishing to make the harbour.

It should be remembered that almost all vessels which frequent Hartlepool come from a southerly or easterly direction.

With regard to the general state of the harbour, and the steps I would recommend to be taken for its improvement, I am unable, as yet, to give a decided opinion.

The engineer whom I employed to make the surveys is a gentleman on whose skill and accuracy I have the greatest reliance. He has accomplished the work in the most satisfactory manner by means of these surveys. Accurate, and I think, sufficient data will be obtained to enable me to come to correct conclusions as to the state of the harbour, the natural causes which affect it, and the means which should be adopted to improve it; but to do so, the present state of the harbour must be carefully examined, new surveys made and compared with the former ones, to ascertain the changes which have taken place in the interval between the two surveys, before I can come to these conclusions.

In the mean time I may make one or two remarks on some points to which my attention was particularly called when on the spot.

1st. As to the effect of sluicing from the slakes. Captain Slater, who surveyed the harbour in 1840, expressed an opinion that the efflux of the tidal waters alone might keep the channel open, and, in one instance, he found the depth of water on the bar, after sluicing, actually six inches less than before.

Subsequent experiments particularly, as detailed in a Report by Mr. Murray, in 1844, prove that this is at least not the usual result of sluicing. He says, "After five sluicings, terminating on the 18th March, 1843, the bar was found to be 30 yards beyond the outer white-buoy, having two feet five inches of water upon it, being an increased depth of 18 inches."

Captain Slater admits that the period of his sluicing was unfavourable, there being two feet of water at the gauge above the zero of good tides; but, even then, it seems that it had the effect of straightening the channel, which had been deflected to the S.W., and this may probably account for the singular fact of the bar being raised six inches. It may have been so in the point where Captain Slater sounded, whilst other parts of the bar in the new and straight channel might be lowered.

However this might be, further experience has left no doubt on the subject that the bar is lowered, and thrown farther out into the bay, into deeper water, where, of course, it is less obnoxious. There are other reasons which lead me to think the opinion erroneous that the efflux of the tidal water alone would keep the entrance of the harbour clear; one is, the state in which it was previous to the making of the present channel and tidal harbour. There is, I believe, no doubt, that it was entirely filled up with a deposit of sand and materials left by the sea, to the depth of several feet, and that the old entrance and inner harbour were rendered totally inaccessible.

The tidal flow had, therefore, failed to keep it clear, and it would, doubtlessly, fill up again if left to itself.

Another reason is, that the surface of the slake is about 12 feet above the bottom of the channel; there would be, therefore, no useful effect from the natural basin or scouring reservoir, as it would be nearly uncovered before any benefit could be derived from the water it contained as a sea-way passage.

If the distance of the bar from the sluice be considered great for the water issuing from them to produce any effect, it must be remembered that its rapidity is much increased by the contraction of the channel; this is a point, however, which is easily ascertained, and which I intend carefully to determine, as much depends upon it, the benefit of the sluices being in direct proportion to the increased velocity of the current at the bar during the time of sluicing, compared with what it is in the ordinary state of the ebb-tide, when sluicing is not resorted to. Mr. Murray states it to be at the rate of 10·227 miles in an hour between the jetty and the pier-head.

My own opinion is very decided as to the usefulness of the sluicing.

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If, however, doubt should exist, it might be effectually set at rest by leaving it off for a time, having first taken the soundings very carefully.

It would of course soon be ascertained whether the depth over the bar was increasing or diminishing.

Till a late period, no idea could exist that the sluicing could possibly be injured, but now that other docks are being constructed in the bay and within the port, it becomes the duty of the Commissioners to protect the entrance to their harbour, and be assured that nothing is done to injure it.

In this point of view, it may become a subject of inquiry whether the sluicing places any deposit in the bay in the direction of the New Docks, and if so, to what extent? and if it should prove injurious to their entrance, it might then be desirable to inquire how far sluicing is necessary or useful to the old entrance into the harbour, and there might be a balance of interests which the Commissioners would have to weigh; they must, however, always bear in mind, that no other part of the bay can ever equal in importance the entrance to the old harbour, not merely because it is the old one, but because it is made by nature infinitely the best and safest, from the protection of the land and Heugh; and they must not allow any consideration to outweigh the preservation and improvement of this part of the port.

The first question is, whether there is a deposit caused by sluicing or not? If there is, where does it come from, and whither is it brought, from the slake or from the sea?

I am not in possession of facts to enable me to state decidedly which is the case, but it can, I think, be easily ascertained.

Mr. Robinson, I believe, some time ago surveyed the slake; that survey, and the more recent one made by my assistants, would fully decide the matter, by comparing the first state of the slake with what it was when these surveys were made.

If the deposit be sand, it would follow that the deposit is not from the lands.

Another point of inquiry would be, whether the Victoria Dock has any deposit in it? as these could not have been brought from the slakes.

If the deposit is originally brought from the sea, it matters not whether it is removed by sluicing, or, as Captain Slater supposed, it would be by the tidal action. Removed it must be, and the action of the sluices would only expedite the natural action of the water. The state of the bar into which the deposit is supposed to be carried by the action of the sluices, might be ascertained by the present surveys, as compared with Captain Slater's, but for the circumstance of his datum line being unknown.

It is of the greatest importance that some fixed point should be taken as a datum, to which all the surveys and levels of such a harbour as Hartlepool should be referred; in my surveys the levels and sections are referred to the level of ordinary spring tides, being at the point marked six feet seven inches on the sluice tide-gauge at the entrance of the Victoria Dock, and the subsequent surveys will ascertain precisely the relative condition of the harbour. But though the relative depth of water in the soundings in the bay cannot now be accurately ascertained, in consequence of the want of the datum line, the depths and character of the deposit in the bay may be easily ascertained; and I should recommend immediate steps to be taken for the purpose, by simply trying the depth of sand, &c., to the clay, and seeing whether what lies over the clay is sand, or mud, or gravel, which will directly show whether it has been brought by the sluices or by the eddies in the bay, or by the action of storms.

It will also show whether there is an accumulation, and whether it is of a nature to impede the access to the New Docks, or to prevent anchors from holding.

When these surveys are completed, which shall be as soon as possible, I shall be prepared to give a deliberate opinion as to the best improvement of the harbour.

Meantime, I need scarcely add, that the first point to be attended to is the straightening and deepening the channel past the pier into the harbour. Every exertion should be made to accomplish this desirable object.

I am, &c.,
John Macneill.

To the Commissioners for the Improvement of the Port and Harbour of Hartlepool.

[For Reports by Captain Slater, R.N., Mr. Rendel, and Mr. Murray, see Supplement.]

Stockton.
River Tees.

No. 200.

Evidence taken on the 29th Oct., 1845.

No. 200.

PORT OF STOCKTON.—RIVER TEES.

Examining Commissioners—Aaron Chapman, Esq., M.P., and Captain Washington, R.N., F.R.S.

Present—Messrs. John Wilkinson and G. W. Todd, Directors of the Tees Navigation Company; Messrs. Fallowes and James Wilton, of the Stockton and Darlington Railway Company; Mr. Langley, Commissioner of Newcastle Trinity Pilots; Mr. Walter Grey, of the Coast Guard, &c.

Mr. L. Jackson, Secretary and Receiver to the Tees Navigation Company for six years.—The Acts of 48 Geo. III. cap. 48 and 9 Geo. IV. cap 57, authorize the formation of a company to improve the river by cuts, &c., and to levy dues. The first cut from Blue House Point to Portrack was begun by Chapman, C.E., in 1808; the second, or new cut, half a mile long, made by Price, C.E., to Newport, was opened in 1831, saved one mile in distance, and cuts off a bend in the river. Lord Harewood gave his consent to turning the course of the river for 2000*l*. Embankments have been erected and extensive encroachments made on the bed of the river. Have borrowed 36,000*l*. on which they pay 4 per cent. Act authorizes to divide 10 per cent. on original capital; a 50*l*. share is now worth 105*l*. Total revenue up to April, 1845, 7828*l*., and total debt, 36,500*l*. The managing committee consist of thirteen, of which three are a quorum. Their services are gratuitous. Light dues amount to 1290*l*. a-year. Since April, 1845, the Stockton and Darlington Railway Company have leased the whole of the dues at 8200*l*. a-year, and have thrown the port open, which has already proved a great encouragement to trade. The lease is for nine years, determinable every three years. All vessels entering Tees Bay pay 2*s* 6*d*. per voyage for anchorage and plankage dues to the town corporation, leased by them for a fine of about 630*l*. renewable every seven years from the Bishop of Durham, who holds the same as owner of the port, whether by ancient charter, prescription, or by what right, unable to ascertain; this sum amounts to 5200*l*. a year, and it is again leased to the Railway Company at 700*l*. a-year. No part of this money is expended on the river; it is considered a great hardship by vessels that only come up to Middlesboro', and a trial respecting it took place at Durham but was lost (v. Meeson and Welsby's Law Reports, p. 882). Great complaints of the want of Trinity House notices of the changes that are made in the lights, buoys, and beacons along the coast. Remembers the master of a vessel applying for one, and had not one to give. About fifty copies are usually sent to the Custom House; at least a thousand should be sent to a coal port, and one attached to the papers of every vessel that clears the Custom House.

Mr. James Johnson.—Resident superintendent of the works for nine years; formerly worked under Mr. Gibb, at Aberdeen. The Tees has been improved by the first cut made in 1808; by the second, called the Ford or Causeway or Nun's Channel, made in 1830, and by running out jetties at right angles to the shore, and thus contracting the channel. The lower jetties were run out by Mr. Price; since that Mr. Brooks, formerly resident and now consulting engineer to the Tees Navigation Company, placed many more; it was found necessary to place a breastwork at the outer ends of the northern jetties up to half tide to guide the current, and this had the desired effect. The piles are driven ten feet into clay; has bored the bed of the river and found twenty-four feet of clay. Erected stone lighthouse at Seaton, two

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timber lighthouses on the Bran Sand, a floating light at south buoy, and the beacon on the south shore. All the eleven bay and river lights burn rape seed oil, and are equally brilliant as others along the coast; the saving he considers one-half over sperm oil. Formerly there was a steam dredge on the river; that was sold, and the only one is a crane dredge which can lift stones of half a cwt., and thirty-seven tons of soil an hour: the soil is deposited by the side of the jetties between high and low water. About five thousand tons are raised annually at a cost of 8*d* per ton lifting, and 2*d* per ton depositing. The tide rises sixteen feet at bar, fourteen feet at Middlesboro', and twelve feet at Stockton quays. Extreme tides rise three feet more: is of opinion that the jetties do not impede the flow of tide; the tide is felt up to Worsall, fourteen miles above Stockton. There are no weirs or milldams on the river, but a ledge of whinstone about halfway up is a great impediment to navigation, keels often strike on it; some of it has been removed by the Navigation Company, and there is no reason that as much as is necessary should not be taken away, as an engineer is of opinion that the more tidal water brought into the river the better for the bar; cannot tell how much has been excluded by the jetties and embankments. The difference in time of high water at the bar and at Stockton Quay, a distance of twelve miles, is one hour. Great improvement has taken place in depth of water, and great increase in traffic. A ship drawing sixteen feet water can now come up on spring tides. The river freshes come down very strong, bringing sand and gravel. The quays at Stockton are in a very bad line for preserving depth; all those of stone are tumbling down into the river, as is also an old house: the quays are in a bad state: they are all private except one small one belonging to the corporation; there is no water at low tide at the foot of them; quays of timber might be easily thrown out, and timber piles and wharfs might be carried along the whole river face of the town in a fair sweep for guiding the current, a certain depth of water might be dredged and maintained. The datum or zero line to which the rise of tide is referred, is two feet below the coping on the west side of Cargo Fleet Quay. Stockton Bridge is a fixed stone bridge of five arches, and only barges and vessels that strike their masts can go above it.

MR. WILLIAM FALLOWS.—On the completion of the railway from Darlington to Stockton, in 1825, the first shipment of coals was made, when 7296 tons were shipped; it was soon found that an extensive coal trade could not be carried on at Stockton owing to the want of water and the long and difficult navigation from the bar, which determined the Railway Company to make a branch to the deeper water at Middlesboro', six miles lower down the river. This was completed in 1830: the shipment of coals went on rapidly increasing at eight staiths or drops erected along the river side; but even here the trade was subjected to difficulties and obstructions, and the continued increase requiring still more facilities, the present dock of Gate was planned by Mr. Cubitt, C.E., and constructed by Mr. George Turnbull, C.E.; it was completed in the spring of 1841. Its entrance channel is rather more than a quarter of a mile in length from the mid stream of the Tees. The entrance lock is 132 feet long, but only 30 feet wide. It has a depth of water on the sill of fifteen feet at high-water neap tides, and nineteen feet at spring tides. The bottom of the dock is excavated three feet under the level of the sills. The sides of the dock are sloping, not quayed. Fresh water for shipping is amply provided.

For the shipment of coals there are ten staiths, at each of which coals may be loaded at the rate of sixty tons per hour.

A branch railway has been laid down at the south side of the town, terminating in ten treble lines of railway, leading to the ten drops. The raised platform, of a triangular shape, covered by these diverging lines of railway, composes an area of fifteen acres, and affords standing room for 1600 loaded waggons, or about 4000 tons of coals, besides egress for locomotives with their trains of empty waggons; and during the last twelve months about 500,000 tons of coals have been shipped here.

Nearly opposite to Middlesboro' on the Durham side of the river is Port Clarence, an excellent shipping place for coals brought down the Clarence Railway, and where also the coal trade is increasing to a great extent, having doubled since 1837, when it was opened, and where 145,000 tons of coals were then shipped. Its dues are about 2000*l.* a-year, which it does not lease to the Stockton and Darlington Railway Company.

There are great facilities for the discharge of ballast in the dock, and on both sides of the river, from which a large extent is being enclosed, and covered with ballast.

Twelve years ago only one house existed at Middlesboro', now there are 6000 inhabitants; and large iron rolling-mills, foundry works, and a pottery company are established. By May, 1846, a railroad will be completed from hence to Redcar on the south side of Tees Bay.

Twenty-four tug steamers, with an aggregate of 716 horse power, are in constant employment, and prove the extensive traffic of the river Tees.

He heard great complaints of large trunks of trees and stones in the river below Cargo Fleet.

JOHN LISTER of Middlesboro' stated, that he had been 33 years acquainted with the Tees, 11 of which he had been a sea pilot, having a Branch from Newcastle; during this period there had been an increase of two feet of water from the sea to Middlesboro'. In the present year he had taken down a vessel of 650 tons, drawing 18 feet of water. Since the lights had been placed in the Tees, vessels could take it with safety at night. During the last 30 years the traffic had greatly increased. Recommends the removal of stones below Cargo Fleet, and from the scalp. At neap tide, ships commonly touch on it; there is a four feet ledge of rocks and many loose stones which might be picked up; *Sea Nymph* grounded on it. there are besides several trunks of trees in the bed of the river; had himself picked one up about two years since. There are from six to nine feet over the bar at low-water spring tides, according as there are one or more channels open. Spring tides rise 16 feet, neap tides 10 at the bar. Is of opinion, that the entrance might be improved by a breakwater a mile and one tenth in length, run out from Seaton Snook, in an east direction, with the object of making a permanent channel over the South Gare. Two years ago the channel opened out to the N.E., now to the N.N.W. The leading lights are shifted accordingly by the report of the buoy keeper. Ships cannot take the Tees in an E.S.E. gale. Out of the 7000 ships now trading annually to the Tees, only two wrecks had occurred in 1844 immediately at the entrance; in 1845 none had occurred. In an easterly gale, has known 13 vessels on shore at once on the main. Steam tugs are to be had easily, but seldom found outside. A pilot smack would be the right thing, and the only way to put pilots on board outside the bar. The improvement had been so great that vessels do not now take pilots.

MR. WALTER GREY, coast guard officer, Middlesboro', corroborates the evidence of the pilots and great increase of trade to the port. Inconvenience is felt from the width of entrance of dock being only 30 feet. Recollects three vessels that could not go in.

MR. JAMES WILTON.—It is a source of constant annoyance to the company, that the entrance gates of the dock are so narrow; vessels consequently are obliged to load in the stream. Since the deepening of the river the tide runs off more freely. At Yarm, was a place constantly flooded—now no longer so.

WILLIAM HOOD, of Seaton Carew, a sea pilot for the last 28 years, brought H. M. S. *Protector* and *Sully* into the river, and anchored them near the eighth buoy. Below the ninth buoy is a dangerous ledge of loose stones. Has known seven feet water over the bar 20 years ago, now nine feet, and the South Gare sand is high. The lights and buoys are shifted as the Bar shifts. Does not consider it his duty to report the shifting of the Bar to the buoy master. River lighted in 1833; cannot be better lighted: so well indeed that vessels come in by night as well as by day; indeed his occupation as a pilot is gone. A pilot smack would be a good thing. Agrees with Lister as to his plan of improvement, by running out a breakwater from Seaton Snook. Has charge of two life boats at Seaton Carew. There one is also at Redcar. Has gone off 23 times to wrecked vessels, and saved many lives. The boats are

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supported by the shipowners of the port, who pay sixpence each voyage. There are also carts—rockets. The life boat carriage wants improving; it is a coarse waggon: there is a good one at Hartlepool, made by Cambridge. A beacon buoy is sadly wanting at the extremity of Redcar Rocks. Several vessels, even steamers, have been upon them, as the *Globe*, *Victory*, &c.

ROBERT LISTER of Stockton, river pilot for 18 years.—About 30 years ago has known a vessel neaped with six feet of water; now a vessel of 11 feet is not neaped. Has within these few years brought vessels drawing 16½ feet of water up to Stockton Quays. Ships usually stop at ninth buoy for tide. There has been great improvement in the river, and very great increase of traffic. The tide certainly ebbs out lower than formerly. If further improvements take place, there will be no longer any occasion for pilots.

D. ROWELL has traded between Stockton and Yarm for 15 years.—Stockton bridge arches are almost blocked up with loose stones from the quarries of Berwick-upon-Tweed, which have been thrown down for the support of the piers. Near Fowler's Shoal there are many loose stones washed out into the river at the foot of the embankment.

JOSEPH WATSON.—The Rogerstone is a large block of whinstone, which extends two-thirds across the river, seven miles above Stockton Bridge; it is much in the way of navigation; has complained of it repeatedly, but got no remedy. Keels have sunk in consequence of striking against it. The Sillstone about 50 yards above is another obstruction. Yarm Shoal dries at low water; tide rises there 7 feet on springs. A keel sunk abreast Black Quarry wants removing. Quay sides at Yarm much out of order. Agrees with Rowell that keels get upon the Rogerstone.

MR. ANDREW SANDERS.—There was a distinct understanding that these stones should be removed if the Yarm people withdrew their opposition; but this promise has not been kept by the Navigation Company.

CUTHBERT WIGLIN, resident at Yarm.—In the opposition offered to the Tees Company obtaining their Act, it was promised to the Yarm people that Rogerstone and the Sill should be removed, stated that 100*l.* had been offered for their removal.

THOMAS WILSON, Trinity Buoy Master, aged   years.—Has charge of replacing buoys and of mooring the leading lights on the Bean Sand. Goes out to sound himself when he thinks it necessary, and is allowed a boat for the purpose. Pilots do not report to him any change of bar; has had to remove the lights three times in one year, and sometimes not once a year.

W. F. MARSHALL, Deputy Harbour Master, 23 years at sea.—It is his duty to berth ships; vessels lie at chains secured round mooring-posts driven down 3 feet under the bed of the river, freshes come down very strong, bringing sand, gravel, and trees; there would be no great difficulty in clearing away the sand from the foot of the quays. The regulations are printed in all the offices, but not made public on a painted board. Agrees with the Superintendent of Works in saying that the quays of Stockton are in a shameful state.

[At high-water embarked in steamer. Remarked that the town quays were tumbling down; some are of earth only. Clarence Quay is falling down, notwithstanding there were many ships at the quays, and every appearance of much traffic. On both sides of the river timber jetties or groynes are run out at right angles to the shore to narrow the channel; they are alternately half and whole tide jetties, with a beacon at the end; lower down, breastworks of wood, planked up to half tide, are placed at the end of the groynes, having 10 feet depth of water at their foot. Encroachments, authorised by Act of Parliament, are making to a large extent on the estuary of the river on both sides.

At Middlesborough landed and inspected the dock for colliers; area nine acres; sloped walls instead of upright quays, to save expense; one side probably will be quayed; lock-gates only 30 feet wide; 10 drops for loading vessels, with a railroad to each; the collieries 30 miles distant; 72 loaded waggons in a train; 42 vessels have been locked out and 19 in in one tide; the river crowded with colliers and tug steamers; the river is lighted by two leading lights below the town; a red fixed light on piles; a floating light and two leading lights at Seaton to clear the South Gare Sand; all lighted with rape-seed oil which is considered half the expense of sperm oil: there are four burners in the float. The fair-way buoy is far too small, the beacon buoy much too small and swims very far from upright. At sunset landed at Hartlepool.]

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No. 201: Price's First Report on the River Tees, 1824.

First Report of H. H. PRICE, Esq., C.E., *on the River Tees.*

GENTLEMEN, *Stockton-on-Tees, 1st May,* 1824.

Understanding that your general annual meeting will occur in the course of the ensuing week, and finding I cannot conveniently remain here longer at this time, so as to be in attendance on that occasion, I conceive you may wish to be informed what progress I have already made towards laying out plans for the improvement of your navigation.

I, therefore, beg leave to report, that in compliance with the instructions I had the honour to receive, I arrived at this place on the evening of the 15th ultimo, accompanied by Mr. William Edgeworth, of whose valuable assistance on this survey I have availed myself. On the evening of the following day, I had an interview with the gentlemen appointed specially by your body as a committee to carry on this important investigation; and on Saturday the 17th, accompanied by two of their number, I proceeded down the river in a boat at low water, in order to make some general observations on the present state of the navigation; and to ascertain, as far as I could do from such a cursory view, what would be the objects to which I ought principally to direct my attention. On this day, as well as in my subsequent investigations, I should have been much assisted if I had been furnished with any accurate plan of the whole river; but, I am sorry to say, that, after the most diligent inquiries, I have not been able to ascertain that anything like such a map has ever existed. The only plans I have been able to procure are, a small one which embraces the space from Stockton bridge to a point a little below Portrack (made about the time the new cut was in contemplation, but which, however, has none of the levels or soundings marked upon it), and the very imperfect charts of Dobson and Thompson of the Tees' mouth, extending up to Cargo Fleet. If such a plan and nautical survey as I have alluded to had been previously made, on which the banks and shoals of the river were accurately delineated, the high and low water marks shown, and the levellings and soundings laid down, with the set and rapidity of the tides and currents at various parts of the river described, my labours would have been most materially shortened; for then I should have contented myself by examining minutely those parts only which appear most to require amendment, laying down, on a copy of such original plan, the present form of the bed of the river, on which, after making a sufficient number of sections, and boring at proper intervals to ascertain the nature of the ground to be removed, my estimates of the expense of the several improvements necessary would be founded.

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In the absence of an accurate survey, which is always the first certain step towards the general improvement of a navigation, any engineer would, in my opinion, be working completely in the dark; and would be in great danger, if he had the temerity to offer any suggestions at all, of inducing an expenditure of money which might be worse than useless, which might be even injurious.

In the course of my examination of your river, I have found its navigation is obstructed by numerous shoals and shifting sands, arising, as I conceive, partly from inattention to the banks, which ought in many places to be protected—the want of which, by allowing them to be washed away, has permitted the form of the river, and the consequent set of the currents, to undergo continual changes; partly from the circumstance of there being no harbour-master to prevent ballast and other rubbish being thrown into the stream, and to enforce penalties when anything of the kind is detected, from which cause I fear your navigation has suffered very materially; but principally from the tidal waters being allowed, in many places, to expand themselves over too wide a space, the great shoals being found to exist where there are two channels—one for the flood, and the other for the ebb tide.

After my first view of the river, on the evening of the 17th, I had the honour of again meeting your committee; when I stated, that I conceived the first thing required was to proceed with such a survey as I have described, as the only sure data on which to form my opinion, and ground my future estimates and report. The matter being, on that occasion, fully discussed, I perceived that the views of the committee were in accordance with my own, and I received their instructions to proceed without delay. I have in consequence ever since been busily occupied in laying out the general plan of the survey, in which considerable progress has now been made. I have had made all the necessary apparatus for sounding and ascertaining the relative levels of the different parts of the navigation; and I have myself taken some of the important soundings, and fixed the standard levels, for a length of several miles along the shores, from which the whole survey and soundings will now be accurately laid down. Whilst all this has been in progress, proper self-registering tide-meters have been constructed under my orders for showing each tide the highest and lowest water, both at Cargo Fleet and at Stockton quays, of which I have directed a correct journal to be kept, that I may, by the time the survey is finished, be possessed of the fullest and most authentic information as to the rise and comparative levels of your tides at different parts of the river—a matter on which, at present, I can only obtain vague opinions, but which it is very important to have clearly ascertained. Besides these, I have made and fixed at various points along the banks of the river sets of staffs, painted black and white, and graduated to feet and inches, in steps of 3 feet each, which indicate the depth of water, at all times, through the deepest channel over the reef of rocks called "The Stones," in a line with Clems beacons, below Cargo Fleet. The water, when its surface is level with the top of the highest of these tide staffs. exhibits a depth of 24 feet through the said channel, whilst the lowest would indicate as little as 6 feet, whenever the water retires so low. These, although intended principally for the guidance of my people in conducting the nautical parts of the survey, will yet be of great use to captains of vessels and others connected with the trade of the port.

After the most mature consideration which I have been able to give, during the fortnight I have been here, to the whole matters submitted to me regarding your navigation, it appears to me that the present trade of the port, and the funds of the company, are inadequate to attempt much more than the improvement of the river between Cargo Fleet and Stockton, where unquestionably much may be effected; and which will probably be best done by shortening and confining its course, and by constructing works which shall secure any improvements so produced from future change. To this part of the navigation, therefore, principally I shall confine my views and estimates of present improvement, and prepare plans for effecting what is most important to be commenced in the first instance; but to speak decidedly now, as to what may be done, and at what expense, is evidently impossible, there being no sufficient data until the survey is completed.

Whenever this is ready, I shall, however, feel it my duty in reporting to you, to submit some suggestions which may at a future time be of service for the improvement of your bar and for facilitating the entrance of vessels into your harbour—improvements, the expense of which ought, in my opinion, legitimately to fall on the general trade of this coast, and not entirely on the particular trade of the port of Stockton, which is in point of fact incapable of effecting them. If any argument were necessary to show, in a national point of view, the importance of effecting a safe and always accessible entrance to your harbour, whether by the establishment of floating lights in the bay, with corresponding beacons within the bar, or by the construction of a breakwater, or by other means, it is to be found in the great number of vessels which have been wrecked, in the property and the valuable lives that have been lost, in the bay of the Tees' mouth, from the want of such an asylum—vessels and property, and lives, too, in no way connected with the trade of this port. When, therefore, I have ascertained more decidedly the practicability of such improvements, without going into a detailed estimate of their expense, I trust I shall be enabled to point out to you the means which may ultimately lead to their accomplishment; and that, too, without laying on your own trade particularly the burthen of their expense.

When I look on the map of this part of the kingdom, at the extensive coal-field north and west of your river, and contemplate the probability of a trade which may, at a future time, rival that of Newcastle and Sunderland; when I think of the vast mineral wealth which enriches the bowels of your country, and see its surface abounding in fertility; when I see large capitals in the course of expenditure, to bring down to your river all the produce of the interior; and all these requiring only facility of communication with the sea to bring them advantageously into action; I am more than ever impressed with the importance of carrying on, with as little delay as possible, every improvement that is practicable in your navigation, and consistent with your means of expenditure: and with this view, that nothing may be wanting on my part, it is my intention to send down to Mr. Edgeworth one or two assistants on the survey, to enable him to complete it in as short a time as possible, as I am particularly anxious to have it finished in the course of the month of June, both on account of my own and of Mr. Edgeworth's engagements subsequent to that period; this arrangement, I presume, will meet your views. It is then my intention to come down again the latter end of June for two or three weeks to complete my investigation, and to lay before you my plans and sections of the river, and estimates for the improvements I would suggest to you, with my report and opinion on the subject.

I have, &c.,

To the Tees Navigation Company. HENRY H. PRICE, C. E.

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No. 202.
Price's Second Report on the River Tees, 1824.

Second Report of H. H. PRICE, Esq., C.E., *on the River Tees.*

GENTLEMEN, *Stockton-on-Tees, 1st Nov.*, 1824.

On the first of May last I had the honour of reporting to you the progress I had made in a survey of your river, with a view to lay before you the plans I would suggest for its improvement. At that time I received instructions to confine my views to the space comprehended between Stockton Bridge and Cargo Fleet,* to which, in consequence, I have strictly adhered.

I should have completed my plans, and submitted them to you, at a much earlier period, but that Mr. Edgeworth, my assistant in the survey, was, shortly after I left him, called on to give evidence before Parliament respecting the Irish survey, and subsequently obliged to go to Ireland, which prevented my sending him down the assistance I proposed until a much later period; and thus its completion has been unavoidably protracted to the present time. Having now completed the plans, and maturely considered the present state of your river, with the causes which have contributed to place your navigation in the deplorable state in which I have found it, I am prepared to suggest to you my opinion of the measures necessary to be pursued in order to give you a good, deep, and permanent channel between the points referred to my consideration.

That you may better understand the remarks I shall have occasion to make, and the plans I submit, I beg to present you with two maps of the river, made from the most accurate survey; which exhibit, that on the smaller scale (of 10 inches to a mile) the whole of the river between the places before named; and that on the larger scale (of 40 inches to a mile), embracing the space which lies between Stockton Bridge and Newport. These maps have numerous soundings marked on them, taken from high water mark, ordinary spring tides. They show also the low water mark, and point out, in the clearest possible manner, the depth of the river at various places, with all the shoals and obstructions so much and so justly complained of by the mariners frequenting your port. The sands as they were before the late high land floods are distinctly picked out, and the deep channels near them precisely correspond with the strongest set of the current both at flood and ebb tide. From these it will appear most incontrovertibly, that wherever the form of the river and its expanded width are such that the strength of the flood passes up near one bank, and that of the ebb returns along the other, a shoal is formed between them. The plans which I have the honour to submit, if followed, are calculated to obviate this difficulty by constructing such works, and making such excavations, as will confine and direct the water of flood and of ebb, as well as the land freshes, always into and along the same channel, which must be made of a regular form and uniform width, to prevent the possibility of eddies and counter tides occurring.

To place the matter in as clear a light as possible before you, I shall enter into a consideration of the subjects, under three distinct heads: the first, that which relates to the improvement of the river from the town to the western entrance of the New Cut—improvements which are so little problematical, that no doubt can remain on the mind of any gentleman, who will take the trouble to examine them, as to their expediency; the second, comprising the space between the New Cut and Newport; and the third, relating to Billingham Reach and the other reach leading to Cargo Fleet.

With regard to the first divison, the quays of the town have, some of them, been so badly placed, and there appears to have been so great a want of a general scientific plan in their construction, that small eddies and partial shoals are occasionally formed, which produce some obstructions to the trade; but as these are not very important, and the remedy would be very expensive, I have not thought it necessary to go into estimates for any work until we arrive at the building yard of Mr. Markham, a little below the town, when the river, meeting with the high ground, sweeps suddenly in a fine curve away to the southward; and, from its continual attrition against its concave bank (which is altogether unprotected) it has, at length, in some degree, undermined the bank, which, being composed of soft clay and alluvial soil, has slipped in large quantities into the river, and been washed away; producing the twofold evil of carrying off soil which is deposited on the bed of the river just below, helping to form the shoal above Page's Point, and tending to give the river a new form; for, by deepening the concavity, unless it be put a stop to, the waters of ebb will rebound against the opposite shore a little lower down, in time cut it away, and thus produce a form still more serpentine than it now posesses. I apprehend your powers do not extend, as on the banks of the Severn and many other rivers, to compel the landed proprietors to protect their own property; and, therefore, I have given an estimate of the expense of sheet piling the foot of this bank, at low water mark, for a length of 200 yards, paving it with stone to high water mark, and removing an old pier, the foundation of which has given way and occasioned it to slip into the river. To remedy these evils, and effectually prevent any further encroachment of the river on this bank, will cost, as appears by the estimate annexed, 446*l.* 2*s.* 6*d*.

The next obstructions we meet with, and certainly very serious obstructions they are to the navigation, are the shoals between the point last named and the western entrance to the Cut of 1810. These evidently arise from the causes I at first pointed out; the flood tide taking one channel, and the ebb another; each forming alternately eddies and still water in the opposite channel. That a deposit from water, embued either with mud or sand, must take place wherever an eddy occurs, is an axiom in hydraulics so well understood that it does not require the slightest explanation. To cure this evil it is necessary to destroy its cause, and this will best be done by projecting jetties, faced with stone, and by giving to the bank of the river such a form as shall confine and direct the waters both of flood and ebb into one regular and uniform course; and this being once done, and the channel dredged out, so as to leave the deep water where it ought to flow, there will be no fear of any future deposit, nor of the river hereafter altering its course.

To effect this most desirable object, all that is requisite is a pier or jetty to be projected from the Yorkshire shore in each of the concavities, one above and the other below Page's Point; and to cut away about 27 yards in breadth of that point itself. The ground taken away will be advantageously used, partly to fill up the spaces between the two last named jetties, and partly to form the cone of these jetties themselves, and of others which I shall propose to you. Since for the purposes of a good navigation, such as your flourishing and increasing commerce requires, it is necessary you should have 6 feet deep at low water ordinary spring tides, or 16 feet at high water, which would enable vessels of 250 tons to trade regularly to your town, all my estimates are founded on this principle. The

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* These instructions were given in consequence of Mr. Price's own suggestion.—*See his First Report*, p. 364.

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ground to be removed can be excavated to low water mark alone by hand cutting and barrows, and the lowest two yards of the excavation (being always under water), as well as the shoals, must be dredged out by a machine. This part of the river also requires a small jetty to project from I. Mills's Island, as shown in the plan, and part of the left bank at the western entrance to the Cut requires also to be removed. All these are more particularly described in my estimates annexed, which will be still further explained by reference to the maps and sections I have the honour to submit; and the total expense of these improvements, including the sheet piling, paving, &c., before named, will amount to 3775*l.* 9*s.* 9*d.* To this part of the river I beg most particularly to call your attention, as it is here any improvement should begin, where it is undoubtedly most wanted, and where there can scarcely be a difference of opinion as to the most eligible plan to be adopted.

The part of the river which comes next under consideration, is the space between the western entrance to the Cut and Newport. In this division of the river we find extensive shoals between the eastern entrance of the Cut and Portrack, and again between Portrack and Newport, as shown on the plan; the strength of the flood setting up along the Yorkshire shore, through the headway to Portrack, and then crossing over, takes the concave shore on the Durham side, till it is shot over at the eastern end of the Cut, against its south bank, which being protected by stone facing, is able to resist it; and it then follows the concave bank of the new channel, until it passes off into the expanded width above it, as before described, whilst the ebb tide and land freshes, following the curve of the new Cut, take the Yorkshire side immediately below it, shoot off to the old pier at Portrack, and then follow the same shore, through the Schoot Roads, until it is forced at the lower end into the curve above Newport, where it is again rebounded and passed down Billingham Reach. The ebb tides and land freshes being the most rapid, and having the greatest scouring effects, as will be seen by an inspection of the soundings marked on the map, always produce the best and most regular channel. To confine and direct the flood tides into the same channel as that which the ebb now takes, occasionally a little curbing each, is then manifestly the only measure which can be advantageously adopted in the space now under consideration, unless a new channel altogether be found practicable. With this view I have laid out the plan for projecting the present embankment at the eastern end of the Cut 120 yards further down, giving it the proper curve both to project the ebb and to receive and give the proper direction to the flood tides. From the old pier at Portrack I would recommend a curved bulwark, of 240 yards in length, with a crescent return or wing wall, faced also with stone, as described in the plan and estimate, to lead the flood tide gently off from the Durham shore, and direct it into the present channel of ebb, above described. The concave bank of the river below Portrack, into the entrance of the Schoot Roads, for a length of 400 yards requires that the foot of the bank at low water should be protected by sheet piles, and paved with stone, like the bay below Mr. Markham's building yard, already described. The upper end of the head way should be effectually banked up by a dam of clay and earth, which will stand very well in that situation, with side slopes of three on the base to one perpendicular, without any facings of stone, and thus prevent the escape of the water of flood between Mr. Hustler's Island and the Yorkshire shore. The lower part of the reach on the south-western shore, and all the way down to the upper pier at Newport, requires the construction of strong jetties and breakwaters, or ramparts, as shown on the plan and described in the estimate, to prevent the waters both of flood and ebb shooting so far into the deep bay on the Yorkshire coast above Newport. These will require to be most carefully and scientifically constructed, and when once made there can be no doubt but the channel, as marked out in pink shade on the map, would maintain itself in its then deep and uniform course. On this plan about 60 acres of land, now overflowed by the tide, would be reclaimed, which in process of time would become a very valuable property. The total expense of all these improvements, which are minutely and particularly described in the annexed estimates and delineated on both plans, would amount to 6707*l.* 1*s.* 4*d*

If this plan be adopted, vessels trading to Stockton will still be liable to detention from contrary winds; for suppose they can fetch up as far as Newport with the wind from the northward, they might not be able to reach Portrack; and again, if it were favourable enough to get up to Portrack, they might be obliged to wait for a fair opportunity of getting up to the New Cut, and this kind of detention would in many sorts of trade be a most serious inconvenience. In like manner, vessels going down the river may, from the same causes, and the very deep sinuosities of the channel, be prevented getting to sea, and thus often lose a fair wind; and, what is of more importance to an agricultural country like this, perhaps miss the best market for the produce they may be carrying to London and other places. Thus it will, I am sure, appear evident to every gentleman interested in the trade and prosperity of Stockton, that it is not a deep water channel alone that is requisite to give facility to commerce; and, as the evils I have pointed out are of a serious character, I have thought it advisable to survey and estimate the expense of a new line of channel altogether between the points now under consideration. I have marked on the map the line I would recommend through Mr. Robinson's marshes, which will lead the water, both of flood and ebb, fairly, and with an equal current, both up and down; and direct them, without liability to diverge, into the present channel above and below the projected cut. In this case the present Portrack channel should be dammed up altogether across the present cut, and a pier or jetty projected at the lower end, on the northern side of the new channel, 120 yards into the present bay above Newport; and the opposite or southern bank of the projected cut must be paved with stone, 18 inches deep, from low to high water mark, for a length of 50 yards, to protect it from the wash of the waves from Billingham Reach. The average width of this channel, as shown in the section, being 118 feet at bottom, 182 feet at high water mark, its depth being 16 feet, the total expense of the improvement, exclusive of the purchase of the land, would, according to my estimate, be 10,923*l.* 0*s.* 7*d.* This would, in a few years, reclaim about 115 acres of land, now overflowed by the tide, which would be converted into valuable marshes; and vessels of 250 tons might then frequently reach the quays of Stockton the same tide they come in over the bar; for the same wind that would admit of their coming to the anchorage near Havertoo Hill would be fair to bring them all the way to up the quays of your town. They would besides, for a length of 1200 yards, have an admirable towing path, which would be a most important advantage. This plan, therefore, considering all circumstances, I think infinitely preferable to the other last estimated of improving the present winding course of the river by way of Portrack.

I come now to consider that part of your river lying between Newport and Cargo Fleet. I have caused all the shoals and sands, comprised in this space, to be most carefully laid down on the map, and the soundings are very accurately marked. In the Billingham Reach, which is of great length, the principal fault is, that it is wider than is necessary to carry off the waters of the river and of the space covered. This arises from its banks never having been protected, and the channel never having

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been confined by jetties and other means into a proper width. For the want of it the waters meander along its soft and sandy bottom wherever any fortuitous obstruction may give them a direction; and thus, in one part, a little below Newport, merely a few roots of trees, and some stones formerly used by the monks as a causeway, have given the waters of ebb, and consequently the channel a tendency to pass from the Yorkshire to the Durham shore. The remedy for this appears to me to be very simple, and I have sketched on the plan the position I would recommend for placing two jetties or piers projecting from each shore, directly pointing towards two others from the opposite shore; these are particularly described in the estimates. At the lower end of this reach of the river, where it unites with that leading to Cargo Fleet, we find a wide and frightful expanse of sands, which, being effected by a variety of circumstances, are subject to continual changes of form, and thus no chart can be depended on for bringing vessels up to the town, without the aid of a pilot's knowledge of the last formed channel; for sometimes the deep water is in one part, and sometimes in another of this dreary expanse. The general tendency of deep water is, however, along the shore of the Yorkshire coast, round the bay by Haverton Hill, as shown in the plan. Commanders, nevertheless, very much prefer the narrow channel nearer the southern shore; because if they once get into the deep bite of the Haverton Hill Bay, they find it difficult to work out again. Here, as in the other parts of the river, and to a much greater degree, do we find the want of a confined channel of regular form; and, after mature consideration, I am induced to recommend the formation of bulwarks and breakwaters strongly faced with stone, as described in the estimates annexed, to give the river at this point a regular curve, confining its northern bank much nearer to the Yorkshire shore than is at present the case, and completely damming up the present circuitous channel by Haverton Hill. The included space would then, in the course of a few years, become valuable land, and the concave shore of this curve being so well protected by the stone paving I would give to the works I have proposed, I apprehend there can be little fear but the difficulties now complained of would be effectually removed and a deep channel permanently secured. At Cargo Fleet it will be necessary to construct a very strong mole or breakwater, projecting about 260 yards from the Yorkshire coast into the channel, as marked on the map, to turn the waters of flood tide away from the south side of the river, and direct them along the side of the deep embankment on the Durham shore; there will then only require a pair of jetties to be formed in this part of the river on the same principles as those in the Billingham Reach, and for a similar purpose. All these are fully described in my estimates annexed; the total expense of the proposed improvements, between Newport and Cargo Fleet, being about 15,591*l.* 1*s.* 10*d.*

The aggregate expense of all the improvements estimated would then be, if the Portrack channel be still adopted, 26,073*l.* 12*s.* 11*d.*; but if it be deemed more eligible to form a new channel across Mr. Robinson's marshes, the amount will be 30,289*l.* 12*s.* 2*d.*, besides the purchase money of the land.

Should these improvements ever be carried into effect, you will have a form of channel of nearly uniform depth and regular current, as shaded in the map within the pink lines, equal, if not superior, to any river in the kingdom similarly circumstanced; and well calculated, as far as the river would be concerned, to carry on an extensive trade by merchantmen of a very respectable class—certainly of 250 tons.

When we look back at the vast increase which has taken place in your commerce since the first opening of the cut of 1810—an increase certainly to be attributed, in a considerable measure, to the improvements you then effected, and to the facility thereby afforded to shipping, I think it is perfectly reasonable to expect, at least, a corresponding increase, and a farther augmentation of your revenue, from the adoption of the still greater improvements which I have now the honour to propose to you. When your navigation shall be sufficiently improved, there can never be the least danger of the trade being carried on nearer the mouth of the river. If we look at the position of London on the Thames, which is precisely a similar case, although on a gigantic scale, we may deduce from it the most satisfactory conclusion, that the more a good navigation for shipping can be carried into the heart of a country, the more is that country likely to flourish; and the shipping port which lies in the centre of all this surrounding wealth cannot fail to feel a commensurate advantage. If, however, improvements in the navigation be not effectually set about, I confess I have some reason to fear, that the plans now in agitation for a northern railway may, if carried into effect, be the cause, in the end, of removing much of the trade of Stockton lower down the river; if, however, the navigation receive all the improvements of which it is capable, I conceive no trade can be carried on lower down, but such as would be productive of great advantage to the town and of revenue to the port. In that case, I should as soon expect the trade of London to be carried on at Gravesend, as that of Stockton at Haverton Hill.

Not having been instructed to enter into any calculations to show how the money, necessary for such improvements as I have suggested, is to be raised, I have made it no part of my business to collect all the data requisite for such an inquiry; I would, therefore, only submit, that if an additional duty of 3*d.* per ton were laid on all shipping coming into the port, the revenue it would produce, in addition to the surplus of your present income, over and above the regulated dividend of 10 per cent. on the original debentures of your shareholders, would, in all probability, form a fund sufficient for the purpose of paying a fair per centage on the money expended in all the improvements I have pointed out; and the income from the increased trade would, I have not the slightest doubt, form a sinking fund capable of paying off, in a few years, the whole capital required; thus leaving you an admirable navigation, free from the incumbrance of heavy port charges. If an Act be obtained for the purposes I have described, the interests of the present shareholders ought to be protected in the fullest manner; in common justice they should be secured their dividend of 10 per cent., on the faith of which they expended their money—beyond which they cannot go: and I am very confident that on the surplus income, supposing an additional 3*d.* per ton to be levied on shipping, Government (the Loan Commissioners) would lend a sufficient sum of money for your purposes at 4 per cent. In the event of any such measures being entertained by your body, I would strongly recommend that you lay before Mr. Telford, who is at the head of our profession, and certainly the most eminent man of the day in his line, the whole of the plans I have had the honour to submit to you: it would be satisfactory both to you and myself to have the aid of his excellent judgment and great experience, before you enter on so serious an expenditure as I have suggested to you.

Annexed I beg to lay before you an account of the tides, which has been kept from the self-registering tide-meters, which I caused to be erected in your river. If the account be continued for twelve months, it will afford the most satisfactory data for a tide table, to be published for the special use of the mariners frequenting your port—a thing at present much wanted.

In conclusion, I have only to regret, that my instructions did not extend to completing the survey

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and examination of your navigation, as far as the deep water over and outside your bar, there being at present no accurate chart of the entrance to the Tees; such a survey, if published, would be of incalculable advantage to the public and your own trade in particular.

I have, &c.,

HENRY HABBERLY PRICE.

To the Tees Navigation Company.

No. 203.
Brooks's Report on the River Tees Navigation, 1846.

No. 203.

Report by W. A. Brooks, Esq., C.E., on the River Tees Navigation.

SIR, *Newcastle, January,* 1846.

In pursuance of the instructions of your committee communicated to me by Mr. J. R. Wilson, I have on the accompanying plan and sections explained my views as to the improvement of the estuary of the Tees.

In submitting this plan to your committee, I have happily, not to encounter those deep prejudices, arising from want of experience with which a measure, so apparently difficult, would probably be assailed in other places. The extensive works which have been already executed by the Tees Navigation Company; the many sand-banks which have been removed from the channel of the Tees; the confidence which your committee have obtained by experience, that by a right direction of the current the most important changes may be effected at a small expense, give me the assurance that the plan now placed before them for the general improvement of the estuary, will be considered in its proper light, viz., as of works which, great in themselves, were they to be executed by manual labour alone, are nevertheless of easy accomplishment when a powerful stream is brought into action to assist the hand of man.

That small causes may in some cases produce great results is nowhere more evident than in the mutations which have taken place in the estuary of the Tees within the last century; and as it is my desire to recover for the trade of the port the advantages which a former condition of the estuary produced, I shall proceed to show what has been the nature and extent of those changes.

Former condition of the Estuary of the Tees.

From the information which a few years ago, I obtained from some of the most experienced of the pilots for the port of the Tees, as well as from the authority of the accompanying charts of the Tees, the oldest of which is stated to have been made in 1762, and corrected to 1789, and the other published in 1805, it appears that at those dates the sailing course into the Tees was east and west by compass, so that during the most dangerous gales to which the north eastern coast is subjected, and by which the greatest loss of life and property is produced, the Tees presented a ready shelter to the embayed, and probably nearly disabled, ship.

With this highly favourable course into the Tees there also existed 9 feet water on the bar at low water of spring tides, or quite as much as when at other times the channel has been 8 points more northerly.

As a further corroboration of the embouchure of the Tees according to this ancient chart, it contains the following observations:—

"The 2nd, 3rd, 4th and 5th buoys you may leave a little on your starboard side in coming up the river, but the 6th on your larboard side, where you may anchor in safety."

"If any ship should be forced into this river by bad weather, and can get within the north Gare, make hold with it for it is steep to, or if any of the buoys should be broke loose, endeavour to keep Stockton Church (if you can see it) a small ship's length open to the northward of Holm House, which will run you safely along the 3rd buoy."

This chart of 1805 has this course clearly defined by rhomb lines. By daylight there was a free and straight course from sea lying east and west by compass. I have laid down this course, or the former position of the mouth of the Tees, on the accompanying large chart, so that it may be compared with the more recent surveys made by the late Captain William Hewett, R.N., in 1831, and by myself in the winter of 1838-9.

By reference to the local objects given in the old charts, we are enabled to fix the true position of the entrance notwithstanding the inaccuracies which nearly all such ancient surveys are found to contain.

The first accurate survey of the bay and estuary of the Tees was made by the late Captain William Hewitt, R.N., whose important labours on this coast, as well as those by the late Commander Slater, R.N., are I regret to find not so generally used as they ought to be by masters navigating this coast, many of whom still continue to adhere to the old patched-up charts, with all their errors thick upon them, and I doubt not that this is one great cause of loss of life and property.

By Captain Hewett's survey, we find that the position of the bar buoy was one mile and three quarters more to the northward than in the earlier surveys above referred to, and the course into the Tees for the first half mile, or to the first black buoy, was nearly N. by W. and S. by E., the channel gradually changing, with a radius of about one mile, until the course to the fourth buoy was from E.N.E. to S.W., and from the latter to the anchorage above the 5th buoy, the course was from N.N.E. to S.S.W.

This was the worst state of the navigation of the Tees, but about this period a gradual improvement took place, and on my own survey, made in the winter of 1838-9, the course from the bar buoy to the 3rd white buoy was N.N.E. and S.S.W., and thence to the floating light nearly E.N.E. and W.S.W.

For several years the channel varied very little from the course last described, recently however, the current has resumed nearly the same channel which it occupied according to Captain Hewett's survey. The chart accompanying this report, has both these channels described on it, and from the foregoing account we find that the direction of the sailing-course into the Tees has varied as much as nine points of the compass, or from an east and west to a north by west and south-east course.

That it is of the highest importance to the trade of the port to have the current confined within permanent bounds as nearly as possible in the direction of the channel 1805, will I believe be readily admitted by all who have practical information as to the necessities of the port, and I am of opinion that this great object may be effected without going to an expenditure which would be a burthen to the trade of the Tees.

Although the prevalence of particular gales of wind at any period may have the effect of changing for a course of time the direction of the lower reach of a river, or the position of its bar, yet I am of opinion that the great alteration which has taken place since the survey of 1805, has rather to be attributed to the operations of changes in the state of the channel higher up the estuary.

While the sailing-course into the Tees remained so long in an east and west direction, the state of the channel above the North Gare was very different from what it has ever since been.

A very large proportion of the ebbing waters was then discharged by the channel which existed on the north side of the estuary, along the Greatham shore; and under Seaton Snook, in what is called "the low hole," vessels which had entered the Tees for refuge, or from meeting head-winds, were accustomed to lie moored in the deep water of that channel.

The course below the junction of this northern with the southern channel was the resultant due to the direction and power of both, and therefore produced a more easterly outlet than that which since the

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closing up of the northern channel is due solely to the influence of the direction of the current through the southern channel.

Under present circumstances there is no reason to expect a restoration of the entrance to the Tees which existed between 1762 and 1805 without the adoption of means to guide the current from above the North Gare in the channel I have proposed, so as to give it an easterly outlet in the lower reach of the estuary.

The closing of the north channel was, I conceive, the result of the embankments on the north side of Cargo Fleet reach, previous to which the ebbing water was enabled to enter the north channel after it had quitted the reach above-named. By this embanking in of the island which existed in Cargo Fleet reach the current was thrown more to the southward, or over that part of the channel below Cargo Fleet Mill, which is commonly known by the names of "the scalp," or "inner stones." the same consisting of hard clay mixed with stones. In a previous report I pointed out that this bank of clay dipped to the northward, so that by the construction of works to ease the curve, we should, at the same time, get clear of this serious impediment to the navigation.

These works having been ordered to be constructed, I have only to urge their speedy execution, satisfied that very beneficial will be the results produced by them.

On the chart I have shown the course which I' propose the ebbing waters shall be led into below Cargo Fleet, and the groins or jetties which will effect this object.

The whole commence from the south side of the present channel, with the exception of a work on "the Seal Sand," the use of which I shall refer to presently.

I propose that they shall only be carried up to the level of five feet above low water of spring tides, or to the level of the adjoining lands, so that they may be rather looked upon as works forming portions of the present banks of sand and mud by which the channel is now confined.

By adopting the channel I have proposed the navigation will be carried to the northward, or clear of the inner or outer stones, and a deep water channel will be obtained.

The outer stones (a ridge of rock which stretches right across the channel below the ninth buoy) dip from the south to the north, and from trials which I have made on the seal sand I find no trace of any rock where the channel is proposed to be directed, so as to bring the current of the ebb into the same channel which the flood naturally takes from the position of the floating light. Hence the formation of the flood tide swatchways in the seal sand. My object is therefore to bring the current of the ebb, which is under command by the construction of works of moderete cost, into that channel which the whole ot ebb to the southward, forming the circuitous navigation over the outer stones by the ninth and eighth buoys. the the flood-current would take were it not, as at present, divided by the influence of the channel made by

This ridge of rock, or "the outer stones," forms a most favourable base for stopping up the present circuitous southern channel. If this were, however, commenced before the construction of any work on the seal sands opposite, it would merely have the effect of obtaining a deeper channel through the southern point of the seal sand, and in order to force the channel more to the north, with the object of eventually getting that direction of the ebb which is necessary to obtain the easterly outlet before referred to, we should have the additional expense of forming a deep water-groyne, possibly for the entire distance to the south side of the proposed new channel through the seal sand. It is for this reason that I recommend the channel over the outer stones to remain unaltered until the groyne is constructed from the north side of the channel at "the stones," to the south side of the proposed new channel at No. 3, so that when once the channel over the stones is commenced to be filled up, the current will not be able to act upon any other part of the seal sand, except to the northward of this groin, or in the direction of the intended channel.

No scour can take place upon this jetty or groin, because it will be driven level with the present surface of the seal sand, and therefore, although of great length, it will not be an expensive work. It will for the greater portion consist of piles and sheet piling, the former of 15 and the latter of 10 feet in leogth, and further protected by a deposit of chalk rubbish, beaten into a trench of 2 feet in width and depth on each side of the jetty for its whole length.

At intervals of every 50 yards trenches at right angles to the jetty should also be cut out of the sand, and in a similar manner filled up with chalk rubbish.

At the north and south ends of this long jetty or groin it will alone be requisite to have longer piling, defended at either end with chalk rubbish and rubble, so as to counteract the scour which would otherwise there take place, on the opening out of the new, and the damming up of the old channel over the stonee by an embankment of clay, chalk. rubbish, and rubble.

This is the safe way to go to work to open out the proposed channel; but. nevertheless, I am of opinion, that with vigilant attention to the proceeeings above, it may be quite possible to dispense with a very large portion of this precautionary work across the seal sand, and simply construct one-fourth of the work at each end, filling up the central half of the groyne by means of a larger deposit of chalk, rubbish, and clay.

The effect of the construction of the jetties across the channel at the upper and lower middle sands will, however, enable a decision upon this point to be come to. If, as I believe, their result will be the formation of a channel through the west side of the seal sand, making a junction with that portion to the eastward, which is now *alive* on the flood side, then a very large portion of the works may be dispensed with.

Ballast-wharfs should be erected at the ends of the jetties, and the stone, chalk, rubbish, and cliff, which is raised, should all be deposited so as to form eastern wings, and thus gradually connect the jetties together by a continuous embankment raised to the level of 5 feet above low water.

This embankment may on the delivery of the material be raised to a higher level, but ultimately it should be cast down to the same level as the adjoining sands.

The shore on the north side of the proposed new channel will have to be protected in a similar manner by the deposit of material from the ballast establishments.

The course which I have proposed to lead the current of the ebb into will re-open the embouchure which existed between 1762 and 1805, but with the additional advantage of the whole body of the backwater being discharged through a single central channel; in lieu of the navigation being lessened in depth by the water being obliged to maintain a northern as well as a southern channel.

We have the satisfaction of knowing that without the presence of any breakwater from Seaton Snook across the North Gare, a good channel into the Tees formerly existed in an east and west course with 9 feet water on the bar at low water of spring tides, so that with two leading lights the Tees might at that time have been entered in an onshore gale; and therefore I think that it would be premature to encounter so large an outlay as would be required for any breakwater in so exposed a situation, notwithstanding the additional advantages which it would doubtless give, particularly in getting to sea with a northerly wind.

It will be observed by persons having local information of the nature of the bed of the estuary, that I have, in the plan accompanying this Report, taken advantage of, or brought into useful operation, the hard bed called "the muscle scalp" near the North Gare, which will help to give the desired easterly outset. Upon this scalp a breakwater may at any time be formed, should funds be available, and this place is most favourably situated for forming part of the base of a northern breakwater from the Snook, the depth in the "muscle scalp" at low water being only from 3 to 6 feet.

By the adoption of the channel proposed by me, we get rid of the shoals at the upper and lower middle sands, as well as of the dams across the channel formed by the inner and outer stones, which now have the effect of seriously diminishing the flow, or vertical rise of tide which would otherwise he had in the Cargo Fleet Reach, which is now 13 feet when the rise on the bar is 17 feet. The difference, by the improved channel will be reduced to about eighteen inches.

Annexed is an estimate of the new works proposed in this Report for the improvement of the estuary.

I am, &c.,

To the Chairman of the Committee of the Tees Navigation Company. W. A. BROOKS, M. Inst. C.E.

APPENDIX B.

STOCKTON.
River Tees.

No. 203.

Brooks's Report on the River Tees Navigation, 1846.

Estimate of the Cost of the Works proposed by W. A. Brooks, C.E., to improve the Navigation of the Estuary of the Tees.

				£.	s.	d.
Jetty No. 1, below the inner stones 1050 feet, formed at 30*s.*				1,575	0	0
,, 2, 1500 feet formed at 30*s.*, and 170 feet formed at 10*s.*				2,335	0	0
,, 3, opposite the outer stones 100 feet formed at 30*s.*						
	650	,,	20			
	50	,,	45			
	50	,,	30	2,383	10	0
	650	,,	20			
	1,500	,,	10			
Closing up the channel over "the outer stones" by a dam raised to the level of the seal sand, or five feet above low water of spring tides, having a top-breadth level 20 feet, and with slopes on each side of four feet, horizontal to one perpendicular foot; the whole to be puddled and hand-packed on the slopes with stone of 12 inches thick, and no stone to contain less than two cubic feet if placed above the low-water line, and one cubic foot below 28,888 cubic yards at 4*s.*				5,777	12	0
				12,075	2	0
Add 20 per cent. for contingencies				2,415	0	4
				14,490	2	4
To which must be added the estimate of Jetty 4 at the inner stone, (see plan and report by W. A. Brooks)				720	18	8
				£ 15,211	1	0

W. A. BROOKS.

REDCAR.

No. 204.

Cubitt, on an Asylum Harbour.

No. 204.

REDCAR.

Mr. CUBITT's *Report on* Mr. BROOKS's *Proposed Plan for the Formation of an Asylum Harbour at Redcar.*

16, *Parliament Street, London,*
31*st January*, 1835.

SIR,

In conformity with instructions contained in yours of the 8th ultimo, I proceeded to Redesr on the 8th instant, in order to examine and report relative to the formation of the proposed asylum harbour of Port William, viz.:—

1st. "As to whether the locality is or is not favourable for an asylum harbour, with a view to the preservation of ships and their cargoes navigating the eastern coast of England.

2nd "As to its practicability, and probable cost. And,

3rd. "Whether the proposed harbour (viewed solely with regard to the preservation of ships and their cargoes, and its general utility), is commensurate in value with its probable cost and maintenance."

Having devoted several days to an inspection of the site of the proposed harbour and its neighbourhood, and taken such observations and soundings as appeared to me necessary, and examined and compared the same with the plans and statements previously published on the subject by Mr. W. A. Brooks, Civil Engineer (who originally planned and projected the proposed harbour), from whom I received much valuable information and assistance on the spot, I now take the earliest opportunity, after my return, to hand you the following observations and remarks, as my report upon the subject to the Committee for the promotion of the intended harbour.

I am, &c.,
W. CUBITT.

To W. Hedger, Esq.

REPORT.

London, Jan. 31st, 1835.

THE object of this report is to examine as to the expediency, practicability, and expense of forming an asylum at Redcar, on the north-east coast of Yorkshire, at the bottom of Tees Bay, on the south side of the entrance of the River Tees, according to the plans and reports of Mr. W. A. Brooks, Civil Engineer, with whom the project originated.

Before going into the above points, to which my attention has been more particularly called, it is, in the first place, but justice to Mr. Brooks to state, for the information of such persons as may have read his report of December, 1832, and examined the plan thereto annexed, that the statements and information therein contained are correct, and by no means overstated, as I had the means of proving by personal inspection, and taking soundings at low water of a spring tide along and across the proposed harbour, in various directions, which agree precisely with those given by Mr. Brooks in his chart or plan of the rocks and harbour; and, in the next place, to such as may not have had the advantage of studying Mr. Brooks's plans, the following brief description may make the subsequent part of this report more easy to be understood.

The north-east coast of England is a very dangerous coast for shipping in easterly gales of wind, particularly that part of it comprised between the Frith of Forth and the River Humber, within which space there are no harbours to which vessels can run and take shelter at the time of low water, or in the night, and the most dangerous part is in the Tees Bay, or its neighbourhood; for, from its being deeply indented in the line of coast, vessels, when caught there with storms in almost any point from N.N.E. to E.S.E., are almost sure to be driven on shore somewhere between Hartlepool and Huntley Foot, and most frequently become wrecked on the "Salt Scars."

The "Salt Scars," together with the "West Scars" and the "East Scars," form a most dangerous reef of rocks (well known to mariners), lying on the south side of Tees Bay, near the entrance of the River Tees. These rocks extend along the shore for about two miles, in detached portions, from the east end of the village of Coatham to the westward of the town of Redcar, with a fine clear beach within and between them, and extend out in an easterly direction to a distance of about two miles from the coast, in two distinct ledges or reefs, their tops appearing above low water for more than a

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mile from the shore, and enclosing a space between them of from two to three thousand feet in width, and from 12 to 36 feet in depth at low water, with a bottom of stiff blue clay. The opening from between these rocks seaward is perfectly clear, and deepens suddenly into 10 fathoms' water, increasing outwards. The rocks are all covered at half-flood, and it is this circumstance, combined with their extent and distance into the sea, which renders them so particularly dangerous.

To the southward of these rocks is a fine clear sand beach, extending for upwards of three miles along the shore towards Huntcliffe Point, and to the northward and eastward are Tees Bay and the southern shore of the estuary of the River Tees.

Now it is in the very midst of these rocks, the present dread of mariners, and of all things by them to be shunned as they would shun destruction, that Mr. Brooks proposes to form an asylum harbour, to which, in the darkest nights, and the most destructive storms which rage on the coast, the seamen would steer with confidence, sure of a safe entrance, smooth water, and good holding ground at all times of the tide, and that in a situation of all others on the coast where it is most needed.

The mode by which this is to be effected is of the simplest kind possible, viz., by forming rubble-stone piers upon the reef of rocks, so as to bring them to sufficient height above high water, and closing up, at the outer end, part of the space between the two rocks with a cross pier, leaving a proper opening for the entrance; by this means a most excellent harbour of about 500 acres will be formed, as will be more particularly seen by referring to Mr. Brooks's plan, in which the coast, the rocks, the proposed harbour, and the high and low water soundings, both inside and out, are most accurately laid down, as I had the means of proving by examining and sounding on the spot, nor did I find any part, either of the description or plans, published by Mr. Brooks, in the smallest degree exaggerated.

Adverting again to my instructions (a copy of which I have inserted in the Appendix hereto) I shall now proceed to state my opinion on the three principal points therein contained.

1st. "As to whether the locality is or is not favourable for an asylum harbour, with a view to the preservation of ships and their cargoes navigating the eastern coast of England."

The solution of this question involves considerations both of a nautical and engineering kind, and without presuming too much on the former branch of knowledge, on which naval and nautical men are so much better qualified to speak, I venture an opinion that the locality is favourable for an asylum harbour, inasmuch as the situation proposed is the most dangerous spot, the most to leeward in a deep bay, where vessels caught with adverse winds find it extremely difficult, if not impossible, to work out, and across which bay probably a larger amount of tonnage passes than along a similar extent of coast in any part of the kingdom.

In an engineering point of view, I have no hesitation in stating that the locality is exceedingly favourable for the preservation of shipping, their cargoes, and, what is of more importance, the lives of their crews, inasmuch as a harbour there formed will be very large, accessible at all times of tide, and with good holding ground for vessels to anchor in; in point of size it will be 500 acres in extent, or double that of Kingstown Harbour, near Dublin, which is, I believe, at present, the finest artificial harbour in existence. In respect to depth of water, it will have 30 feet at low water at its entrance, and carry that depth inwards for nearly three-quarters of a mile, and then begins to shoal gradually to the beach at the head of the harbour, which beach extends for a great distance southward of the harbour, and is exceedingly favourable for such vessels to take the ground as from loss of anchors, rudder, or steerage-way, cannot make the harbour's entrance, but guided by its lights, would run for the beach in the best place with confidence; or if they had ground tackle, they might bring up under the lee of the harbour itself in from 3 to 5 fathoms' water, as the proposed entrance to the harbour is a full mile distant seaward from the nearest point of the beach at low water, as will be seen on reference to Mr. Brooks's chart of the coast and plan of the proposed harbour; and the consideration of all which leaves no doubt in my mind that the locality is favourable for an asylum harbour with a view to the preservation of ships and their cargoes navigating the eastern coast of England."

2ndly. "As to its practicability and probable cost."

As regards practicability,—it would doubtless be practicable to construct a harbour in almost any situation, if means were obtainable for the purpose; and this question would therefore become one of expediency, as to whether it be practicable to construct a harbour possessing very great advantages, for so small a sum of money as would render it advisable to set about it.

Now the easiest way to make this fully understood appears to me to be by drawing a comparison with some known work of a similar kind, and I take the Royal Harbour of Kingstown as a case in point.

I deem Kingstown Harbour to be the largest, the best executed, the most useful, and the cheapest artificial harbour in the British dominions; at all events the best and cheapest in proportion to its size, utility, and the quantity of materials composing it, that I have ever seen; and if it can be shown that an asylum harbour, twice as large in extent, with a greater depth of water, of probably even greater utility, can be constructed at about half the expense, I think the case for Port William will be fairly made out, and its practicability and cost fully proved.

Kingstown Harbour is formed of breakwaters or piers of rubble-stone carried out in the sea, and brought up from the bottom to a sufficient height above high water, with proper slope each way, thus enclosing a harbour from the sea of sufficient extent to answer its intended purpose; the materials are of granite rock, from quarries two or three miles inland, at the back of the harbour, from which the stone is brought down on railways, and pitched into the sea, until the piers are formed of sufficient length and height.

The same mode exactly is proposed to be adopted in the formation of Port William, from the extensive quarries of free-stone which lie just at the back of the proposed harbour, and with this great advantage in favour of the proposed plan, viz., that the greatest portions of the piers or breakwaters are already formed by nature, in the existence of two reefs of rocks, which run out in the best direction for the piers of the intended harbour, and appearing above low water for upwards of a mile into the sea, thus forming piers almost ready made by nature, and which only want raising upon and extending towards each other at their outer ends, for the purpose of an entrance to form one of the largest and best artificial harbours that can well be conceived.

The total quantity of stone used in the piers of Kingstown Harbour is about 5.000,000 tons, and its total cost about £500,000, including every expense, which will give 2*s*. for each ton of granite in place for the formation of the harbour, and taking the difference of expense in the quarrying and working of granite and sandstone, and the greater quantity of space taken up with the same weight of the latter, I have no doubt that 1*s*. 6*d*. per ton would form the same extent or bulk of breakwater at Port William, as 2*s*. per ton has done of granite at Kingstown Harbour.

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The quantity of stone necessary to form the piers of the harbour of Port William, to the extent laid down in Mr. Brooke's plan, would according to my estimation be 3,000,000 tons, and this at 1*s.* 6*d.* per ton, would amount to £225,000 only; and even assuming that the cost of preparation, execution of, and finishing up, the piers, amounted to as much in the one case as the other, the cost would then amount to no more than £300,000 for a harbour possessing all the advantages of size, &c., as above stated.

I am, therefore, of opinion that this work is easily practicable, and at a cost certainly not exceeding £300,000, and probably not exceeding £250,000.

3rdly. "Whether the proposed harbour (viewed solely with regard to the preservation of ships and their cargoes, and its general utility) is commensurate in value with its probable cost and maintenance."

This is a question which I do not feel myself, as an engineer, competent to answer, inasmuch as it involves considerations with which I am not fully acquainted. The probable cost of the harbour I have stated as above; and if once well constructed, its maintenance would be little, principally consisting of management, lights, &c., amounting in the whole probably to not more than £200 to £300 per annum; or even if it were a greater sum, there is no doubt that the trade which would arise in the neighbourhood immediately on the construction of a harbour, would amply pay its current expenses. As regards defraying the cost, that is a question which, in my judgment, concerns the public, and should be treated on public grounds—the consideration being whether by the construction of a safe and easily-accessible harbour on the most dangerous part of the coast, sufficient property and life would be saved to warrant the expenditure of such a sum of money as would effect the desired object; or whether such a slight tonnage could be put upon all loaded vessels passing the harbour as would, in a given number of years, repay the principal with interest of the money expended, and after that time leave the harbour free—all which are most important considerations for the Committee promoting so useful and important a measure.

Hitherto I have only mentioned this as an asylum harbour, for the use and security of all vessels navigating the north-eastern coast of England; but it may be proper also to state that the situation possesses qualities of a very superior order for the use and accommodation of a naval as well as a mercantile "marine," as is clearly pointed out in Mr. Brooks's report and letters on the subject.

In conclusion, therefore, I have only to state, that, in my opinion, after a very careful view and consideration of the subject, the locality is very favourable for an asylum harbour; that its construction is easily practicable; that its probable cost would not amount to £300,000; and that, in my judgment, the same might be carried into effect upon such a plan of finance as, without injury to the shipping interest, would be beneficial to the public at large, be the means of saving many valuable lives, and, in time, become a free harbour, rendering comparatively safe to navigate, by night or day, a part of the coast which is at present the dread of mariners.

I am, &c.,
W. CUBITT.

To the Committee for the Formation of the
Harbour of Port William.

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No. 205.

PORT OF WHITBY.—RIVER ESK.

Examining Commissioners,—AARON CHAPMAN, Esq., M.P.; Captain WASHINGTON, R.N.

Present:—C. RICHARDSON, Esq.: J. HOLT, Esq.; R. CAMPION, Esq.; J. CHAPMAN, Esq.; J. CHAPMAN, Jun., Esq.; and H. SIMPSON, Esq., *trustees of the piers and harbour*; and Lieutenant BRITTAIN, R. N., *of the Coast Guard service.*

(*On the table were several plans and sections of the piers and harbour.*)

Mr. BLACK, clerk to the Trustees, stated the qualification of the trustees; that none held places of emolument, and that the vacancies were filled up by their own election. The duties levied upon ships entering the harbour were to the full extent allowed by the Act, being 2*s.* for a ship of 300 tons. The amount of money borrowed was 18,715*l.*, at 4 and 4½ per cent., chiefly lent by residents, and the principal part has been owing some time. An annual general meeting is held, when the accounts are examined by the chairman, and published in a county paper, a copy also being sent to the clerk of the peace at Northallerton. A harbour-master is appointed by the trustees. That no profit is made by them of ballast taken from the harbour; complaints have occasionally been made of ballast, &c., being thrown into the harbour. The passing toll of one half-penny per chaldron is levied upon all coals shipped from the Tyne and the Wear, except in Yarmouth vessels. The income for the last 10 years has averaged about 3200*l.*, of which about 3000*l.* was for passing toll. The Lord of the Manor levies 1*s.* 4*d.* for laden, and 8*d.* for light vessels, which amounts to about 100*l.* per annum, under a special grant from Charles II., but no part of it is applied for the benefit of the harbour. The bridge dues are 1*s.* 6*d.* for each vessel passing above the bridge, which with 10*l.* a year allowed by the county to each, is received by the men who attend the bridge. The total amount of salaries paid by the trustees, including resident engineer, clerk, &c., is only 325*l.* per annum. The interest paid is about 800*l.* per annum, and the remainder is expended on the piers and harbour. No parliamentary or legal expenses have been incurred since the present Act was obtained in 1827, except in one case with Col. Cholmley, the lord of the manor, in 1841, amounting to about 460*l.* The only extra engineering expenses have been about 600*l.* for the late survey and plans by James Walker, Esq.

Mr. PICKERNELL, resident engineer, stated that he has been employed on the piers for 35 years, the last 24 as resident engineer. His principal works on the west pier have been to raise a great part of it. In 1830, about 90 feet of new foundation were put into the pier, in consequence of its giving way, which was very expensive, owing to several heavy storms occurring at the time the works were in progress. The part adjoining it has given way, and will probably need undersetting. Erected the lighthouse in 1831. The pier is faced with stone not less than 12 feet, and filled in with rubble stone. The east pier was being cased on the outside when he was appointed, and he finished it and rebuilt the end. Also cased part of the inside. Part of the Scotch head is very old. Considers it and the inner piers very beneficial, as they break the heavy

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swell which comes into the harbour, especially with the wind at north-east. Considers a circular head best for the pier, because it gives a lead in to the harbour. Both the pier heads being circular has also a tendency to throw the heavy seas across each other, and thereby break their force. In 1833, superintended the building of the present bridge, towards which the trustees gave 4000*l*., for obtaining the removal of various encumbrances, and the widening of the passage way from 33 feet to 45 feet 3 inches, thereby enabling ships to run above the bridge with their sails set. One of the principal defects of the harbour is the heavy swell, for the removal of which, and for deepening the harbour, Mr. Walker gave a plan. This has been modified, and about 300 feet are to be added to the east pier, so as to narrow the entrance from 290 feet to 150 at the bottom and 170 feet at the top of the piers. The west pier is about 30 feet wide, increasing to 54, and the east pier 35, increasing to 90 feet. The stones used are from 3½ tons to 7, allowing 18 cubic feet to the ton; the whole are got in the neighbourhood, and cost from 8*s*. 6*d*. to 9*s*. 6*d*. per ton, the last being the best Aislaby stone. Has known stones of five tons' weight washed across the pier into the harbour. The port is kept open principally by the land water, the flow of tide into the harbour being small, owing to the limited quantity of water that can be received into it. The tide at Ruswarp mill-dam may rise about three or four feet in ordinary spring tides, when there are 16 feet on the bar. The dam may be about nine feet high, and 1½ miles from the entrance of the harbour. Does not think that the removal of the dam would greatly improve the harbour. The river was diverted by the Whitby and Pickering Railway Company, previous to which from 20,000 to 30,000 additional feet of water might enter the harbour. The old bed of the river, where the cut was made, is gradually filling up. There is a railway bridge at Ruswarp, but not at all injurious. There are several quays or staiths within high water mark, the recesses between which tend to fill up the bed of the river, because of still water. There is a ford across the harbour at Spital, but it is level with the bed of the river; there is also another higher up, formed by the Railway Company to the property of E. Turton, Esq., which was 18 inches high, but it has been partly broken up. Small vessels frequently go over it. There is a place behind the west pier where rubbish is deposited, and part of it is washed round the pier end by the tide into the harbour. Upwards of 48,000 tons of soil have been excavated from the upper harbour by hand labour within the last few years, and carried out to the eastward of the harbour, where it is thrown into the sea. The harbour is of great use, having seen upwards of 60 vessels come in during one tide, and frequently 20 or 30, chiefly light ships; some upwards of 400 tons The rock between the piers is sometimes bare; it might be blasted, but does not think that the depth of water would be increased. During a heavy fresh running out the velocity may be five miles an hour. The alteration of the east pier is calculated to cost 21,500*l*., to be completed in six sections, one being completed each year. The present section was begun on the 1st of July, since which time upwards of 4,000 tons of stone have been laid.

Mr. JOHN ELGIE, the lessee of the mill at Ruswarp, spoke to having seen a boat float over the dam at that place, and that in very high spring tides the water has been level with the top of the dam. The land floods bring down a good deal of gravel, shale, &c., but not so much as formerly, owing to the giving up of some alum works. Never opens the locks for any other purpose but taking the salmon. About half a mile higher up there is another dam, at Sleights, to which place, and as far as seven miles up the river, the bed is very level.

Mr. WM. CLARK, the harbour-master, was master of ships for 24 years, 18 of which were spent on the coast, and has been harbour-master for seven years. Several improvements have been made in the harbour to his knowledge. The mooring posts and buoys are sufficient and in good repair. There is no board placed upon the piers with the regulations. Has complained to the trustees from whom he receives orders, of ballast, ashes, &c., being thrown into the river, and recollects two men having been fined for it. Part rubbish washes from behind the west pier into the harbour. Has seen five feet of sand on the bar, having probed it that depth, and has sometimes seen it quite clear. The land freshes do more good than the tide, but the tide runs more in since the present alteration was commenced, and thinks the extension of the pier and narrowing the entrance will do good. It will give confidence in coming for the harbour. Thinks the circular head best for ships entering, and also for the tides. The worst winds for filling up the harbour are the W. N. W. and N. W. About seven weeks ago 60 or 70 ships came in for refuge in one tide, some of which would probably have been driven on shore by the changing of the wind. Knows Runswick Bay, and accompanied Mr. Cromer to survey it, when he stated it was too small to make a harbour of refuge. In order that 100 small craft might ride very close, it would require a breakwater three-quarters of a mile, which could not be done for half a million of money. Has seen 180 vessels laid up in Whitby harbour, unrigged, besides 30 or 40 sail which were employed, and 20 large fishing boats. Ships may obtain repairs of all sorts. The roadstead is good holding ground, and a beacon buoy has lately been laid down on the edge of the Scar, which is of great service in the day time. The light at the pier end is gas, and not more expensive than oil. Has lamps in case of accident to the gas. It is lighted when there is nine feet of water on the bar.

Mr. JAMES WOOD, ruler of the pilots.—It is 40 years since he first went master of a ship. Once took the harbour for refuge when 77 ships came in, and no material accident happened. One day this year 47 vessels came in with pilots, and several without. The anchorage ground in the roads is good, especially in Soft Hole. Vessels have struck on the bar on entering the harbour. Approves of the extension of the pier, which has already lessened the swell, the greatest evil of the harbour. Great complaints are made about the state of the upper harbour; it wants clearing, and there is no difficulty but the expense. Has seen about 300 ships in the harbour. Knows Runswick Bay; it is a good shelter, with rocks on each side. Mr. Dodd was employed to survey it by the late Lord Mulgrave, and he said it was good but small, and, if made into a harbour, only six sail of the line would be able to ride in from six to nine fathoms water. Considers it or Whitby the place for a harbour of refuge. Few vessels ride in Runswick Bay except small ones belonging to the place.

Mr. WM. SANDERSON has known the port for 37 years. The present state of the lower harbour and the piers is much improved, but the upper harbour is worse than he has known it for 20 years, there not being a fit place to lay a laden ship. Considers that the best things for improving the harbour would be a staith on the south side, and a dredging machine. By narrowing the harbour, the channel would be deepened, and more water thus be admitted. The present altera-

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tion is good, as it will narrow the entrance, and the swell of the sea, which is at times very heavy, is already lessened. Has been riding in Whitby roads with 20 or 40 sail of ships. The harbour is of great benefit to light ships, and would be to laden ones, if the water were deepened. A harbour of refuge is much wanted, and Whitby is the best place. The beacon buoy is of great benefit, but it would be a greater benefit for the present tide light to be made a permanent one, there being no permanent light between Tynemouth and Flamborough Head—a distance of 72 miles. Believes this to be the general feeling among the shipmasters. The Whitby light may be seen 16 or 18 miles. The principal thing required in the upper harbour is the removal of the banks or shoals. Considers that it would be better for the trustees of the piers to borrow money, than to spend six years in effecting the present improvement.

Lieut. BRITTAIN, R. N., has been 30 years in the navy, the last 10½ of which has been spent in Whitby, and has seen a number of vessels take the port. In July last, 70 vessels and 20 large fishing boats came in for refuge in one day, and 40 or upwards is not an uncommon occurrence. With some winds there is great difficulty in taking the harbour, and has seen vessels strike upon the bar, and wash behind the pier. The works now in progress will be a very great benefit, and some benefit to the harbour is already effected by the portion of the pier which has been built. A place of shelter is much wanted on the coast, there being no place for light ships to run to, if between here and Hartlepool the wind change and a gale come on from the north, should the tide be down. Vessels frequently come in during heavy gales from the north, but sometimes are signalled off in consequence of the heavy sea, which breaks a long way out. The entrance to the harbour is far too wide, and considers it would be better if narrowed one-half. Great quantities of rubbish are thrown behind the west pier, and a vast number of tons wash away, part of which finds its way into the harbour round the pier head. Knows Ruswarp Dam, and considers all obstructions of this kind injurious to harbours, and ought to be removed. Thinks that the water is deeper within the bar, even when the sand is all washed away and the rock clear—perhaps 18 inches deeper. The bar has been quite clear lately, owing to the long prevalence of easterly winds, more so than he has known it. If there were more fresh water running out, the rocky shoal on the bar would prevent its deepening the channel. The extension of the east pier has already improved the harbour.

No. 206.
An Admiralty Surveyor's Report on the Port of Whitby; with Notes on Scarborough, Filey Bay, and Bridlington.

No. 206.

Report of an Admiralty Surveyor on the East Coast of England on the Port of Whitby; with some Notes on Scarborough, Filey Bay, and Bridlington.

H. M. S. "Blazer," Whitby Road,
12th October, 1844.

SIR,

In compliance with your general instructions, to lose no opportunity of examining and reporting upon every port which in the course of our survey we may chance to visit, I beg to acquaint you that having learnt at Scarborough that Mr. James Walker, C.E., was to be at Whitby this morning, we weighed from that Bay at daylight and ran down here, where we are at anchor in the Road, in 9 fathoms water, good holding ground, about half a mile from the pier end. The outer point of the Whitby Scar bearing S.E., the northern extreme of land N.N.W., and thus it affords good shelter to the coasting trade in all southerly and westerly gales.

On landing, I met Mr. Walker; his assistant, Mr. Comrie, who had been engaged for some time in making a plan of the harbour and the entrance; Lieutenant Brittain, R.N., of the Coast Guard, who has been here 10 years, and appears a seaman-like, intelligent officer, and well acquainted with the port; Mr. F. Pickernell, the resident engineer; and Mr. Clark, the harbour master; and walked with them round the piers and examined the harbour.

A stranger's first impression, on setting his foot on the west pier, must be that of admiration at its bold dimensions, both in width and length, and its apparently beautiful structure of the well-known Whitby stone. The picturesque valley of the Esk,—the sharp defined outline of the pier and lighthouse,—and the ruins of the far-famed Abbey on the cliff above, form a striking scene.

On turning to the harbour, a sailor is struck by the contrast: with the exception of the small stream of the Esk, the harbour is dry at low water, and its entrance and sides encumbered by sands; even the light boat in which I landed was obliged to push outside the piers to remain afloat, and the bar dries 4 feet at low-water springs.

Having the advantage of a tide ranging 15½ feet on average springs, 17 feet on good springs, and 20 feet on equinoctial springs, or in a N.W. gale, there does not, at first sight, seem sufficient reason for the bad state of the bar and this accumulation of sand; but a little inquiry as to the condition of the upper part of the river, and an attentive consideration of the relative length and position of the piers, and the width of entrance, will, I think, account for much of the evil.

The latter, however, are partly engineering questions into which I do not feel disposed to enter; but I may state that it is the opinion of the officer of the Coast Guard, who has resided 10 years on the spot, has watched vessels entering in all weathers, and seen many wrecked on the Scar behind the east pier—

1st. That the width of entrance (300 feet) is one-third too great.

2nd. That the east pier should be carried out to cover the Scar to the same length as the present west pier.

3rd. That the piers, instead of running out in a N.N.E. direction, as at present, should have been carried out in a North or N. b. W. direction, fair with the lower reach of the river. This, too, would have given greater shelter in N.E. gales—the worst on this coast—and have prevented much of the swell that tumbles into the harbour.

Lastly. That the billet head of the west pier should have been a fiddle head (to use a sailor's phrase) or turned the other way.

As far as a short visit will enable me to judge, I confess that I agree with these remarks:—1st. If it were quite certain that ample room would be left for the entrance of the tidal water, so as completely to fill the channel above, I would, under the peculiar circumstances of the case venture to recommend the narrowing the entrance even to 180 feet.

2nd. This narrowing would, I think, be best effected by extending the east pier in a north or per-

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haps in a N. ½ E. direction, to the same length as the west pier; and, with every deference to engineers, I should be disposed, in so doing, to curve it very slightly, convexing to seaward; for, as I stood on the pier at low water and watched the puny efforts of the river steam struggling to make its way out, I observed that it naturally curved, as all rivers do, and formed the deepest channel in the bight: this curve would also have the advantage of directing the outset of the ebb to harmonize better (at least for four hours) with the ebb stream along the coast, which here sets to the north-west, instead of meeting it nearly at right angles, as at present.

3rd. The Bar, or rather its nucleus, is formed by a part of the Scar composed of alum shale rock, and in low spring tides the water falls out 2 feet below its surface; so that, however the freshes may scour away the sand, this Scar remains as a weir across the harbour, ready to catch and retain every particle of sand thrown in by the waves. Besides the additional evil of risking a ship's breaking her back upon it in the event of striking, if running in, in case of great need, before a heavy sea. This should be immediately remedied. The alum shale is not a hard rock, and blasting under water has lately become so common a process, that there is no excuse for its being allowed to remain—especially as I understand five vessels have been wrecked on it during the last few years.

The short time I had at command would not allow me to walk along the upper part of the banks of the river; but in reply to my inquiries, I learnt that there are several obstructions to the free flow of the tide, which are incompatible with a good state of the harbour. Such as a ford across the river; a new narrow straight channel in part substituted for the former wider and circuitous one, (said, I think, to have been made by a railway company); and an addition to a quay lately erected projecting into the river some distance below high-water mark; but the great evil is the dam or weir of Ruswarp mill across the river, which completely stops the flow of the tide upwards in its natural channel.

Besides these grievances, it was pointed out to me that the back of the west pier is the usual place of deposit for the rubbish of the town, which at the next high tide is washed down and carried into the harbour on the flood; while, throwing ballast over in the harbour is considered so venial an offence, that three men brought before the magistrate for doing so only the Saturday preceding my visit, were not fined, but only reprimanded.

Need we wonder at the encumbered state of the harbour and the dry bar!

Yet Whitby is a port of much consequence. Here are 14 building slips and 7 repairing docks, employing 300 shipwrights; 50,000 tons of shipping belong to the port; 2000 arrivals and sailings take place annually; its seafaring population consists of 2500; its coast fisheries employ 244 boats and 750 men; quarries of alum rock, whinstone, and freestone, are in the immediate neighbourhood, and the Egton, Aislaby, and Cragwell stone is in request all along the coast for building.

The revenue of the port, too, is 3600*l*. a-year, partly derived either from a passing toll on shipping, or a tax on coal, specially imposed "for the improvement of the harbour."

Here are numerous Trustees of the port, noblemen and gentlemen of the first station in the country, including among them the representative of the town, himself a sailor and shipowner, and one of the most intelligent and experienced members of the Trinity Corporation. I can only imagine, therefore, that the real state of the case is not laid before them. Knowing, as I do full well, the vital importance of a good harbour on this part of the coast, too notorious for its shipwrecks, I would venture to entreat them to see and examine themselves into the real state of the harbour, to take the opinion of one of our most eminent engineers, and to spare no expense till every obstacle is removed that impedes the free flow of the tide, and by dredging and other means to encourage it to flow up the river Esk as far as they can, so as to command all the natural backwater possible. Something was said, if I remember right, by the engineer about damming up water to sluice out over the bar, but having seen in nearly every case in which it has been tried the utter inefficiency of such artificial backwater, I would trust to the free use of the dredge to form a reservoir in the natural bed of the river, which plan has the advantage of securing the unceasing scour of the tide twice a-day, or 704 times a-year; and this scour, joined to the winter freshes, and the removal of the Scar, would, I doubt not, effectually exonerate Whitby from the reproach of being a "bar harbour."

During the two months we have employed on this coast, on the surveys of Scarborough and Filey Bays, which have been completed by Mr. E. K. Calver, master and assistant-surveyor of this ship, we have repeatedly run down here, and each time I have been more impressed with the great want of a large buoy or beacon at the extreme end of Whitby Scar,* which is a very dangerous ledge of rocks, covered, except at very low tides, extending more than half a mile off shore with deep water close to; the same want, although perhaps not to so great a degree, is experienced at the end of Filey Brig and Flamborough Head Ledge. I have lying by me a list of 14 vessels wrecked on the Brig, many of which doubtless might have been warned off by a buoy or beacon at its end. On Flamborough Ledge, you may yourself remember we saw two light colliers at once; and it was here that the "Driver," war-steamer, ran ashore and was much damaged.

Scarborough Harbour might be much improved by the west pier being carried more to the westward, and placed so as to shoot the sand and eddy tide off, past the eastern pier-head, instead of leading it into the harbour as at present. The harbour trustees are crippled in their exertions from the want of funds, the corporation claiming a part of the dues, they have, however, recently evinced much public spirit in clearing out their eastern harbour, and in erecting a self-registering tide gauge at the pier end. Its record is to be accompanied by a barometric register, and a journal of the winds and weather, to be kept in the lighthouse by the intelligent harbour master; this is the first instance on this part of the coast of proper attention to the phenomena of the tides, on which most of our harbours are dependent for their very existence, and we trust that the good example may be shortly followed at other ports in the neighbourhood, and especially at Whitby and Bridlington Quay.

Filey Bay offers fair shelter for a few vessels in north-easterly gales, if they can anchor well up under the lee of the Brig which is a remarkable natural breakwater running off half a mile in a south-eastern direction from the shore. The rocks are of calcareous grit, stratified and abounding in fossils; the strata dip about 12° to the south; a more inviting foundation for a breakwater can hardly be imagined, but unless it were continued round so as to form shelter from east and south-east it would be of little use. Stone is abundant, and to be had for the carriage, and when Government shall be at liberty to attend to the wants of sailors on this part of the coast, which sooner or later must be done, Filey Bay will deserve attentive consideration.

The Spital, as it is called, a small ledge which projects from the Brig in a south direction, appears to have been the foundation of an artificial pier; it is formed of rubble stones of about 2 cwt. each,

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* Placed in June, 1845.—[ED.]

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and may have been intended for the shelter of fishing boats, but never finished: there is no record or tradition of its construction.

Bridlington Bay is the only good shelter in north-easterly gales on this coast, and in a continuance of such winds, 200 vessels may be seen lying here under the shelter of the Smithick Sand, which helps materially to break the sea, and would form an admirable foundation for a breakwater, and so make this bay a harbour of refuge. It was from strong evidence of the value of this bay, and of the utility that would result from an enlarged inner harbour, with convenient access for getting off provisions and water for wind-bound ships, that Parliament granted in 1837 a passing toll to be levied for the enlargement and improvement of the harbour by building a new south pier; under this Act, a sum of upwards of 18,000*l*. has been raised, which appears to have been expended in a north pier, which is a fine piece of masonry, but is little or no shelter to the harbour from southerly gales. In September, 1843, I found the plan for the south pier had only just been decided on; during the last month I have seen the works in progress, and it is said that they are to be completed in Sept., 1846; the pier is to be 330 yards long by 17 yards wide, the facing to be of Whitby stone, to be filled in with square masses of hard chalk; and the entrance of the harbour to be deepened to 18½ feet below the high water of ordinary spring tides.

I trust that special care will be taken to see that the contract is strictly fulfilled, yet blocks of chalk are doubtful materials to be employed as a core to a pier exposed to the heavy sea, which at times breaks in here in a southerly gale, and we know that at Ramsgate Pier, under the lighthouse, it washed out, and was obliged to be replaced by stone. Care will be requisite, too, to see that the foundations are laid deep enough, as the sand is very light, and it may so happen that the very erection may cause a scour along its outer end that would undermine it in a short time.

The landing place at the north pier is so far up the harbour, that boats cannot get near it at low water; and with any sea the harbour is unapproachable at that time except by the Yorkshire cobbles, which are well adapted for taking the beach. I found no tide scale here, and no register of the tides kept; the harbour lights seemed to be but a poor affair; the harbour itself encumbered with sand, and I must add that there appeared many symptoms of the want of an efficient harbour-master.

As both Bridlington and Whitby levy public tolls on shipping, or on coals, it would seem but right that Government or Parliament should have some control over the manner in which such funds are expended.

We sail this afternoon for Shields to replenish our coals.

I am, &c.,
JOHN WASHINGTON, *Captain.*

To Capt. Beaufort, R.N., F.R.S.,
Corr. Inst. France, Hydrographer.

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No. 207.

Report of JAMES WALKER, Esq., C.E., *on Whitby Harbour.*

MY LORD AND GENTLEMEN, *Great George-street, 4th January,* 1845.

The substance of the resolution of your meeting of the 3rd April, communicated to me by the Marquis of Normanby, is,

That I survey the piers and harbour of Whitby, and report my opinion on the best way of extending and improving their capabilities and approaches.

Having in July last dispatched my assistant, Mr. Drane, to measure and plan the entrance and the harbour, and to make observations on the river and tides, I visited Whitby in August, and made such survey as the time and state of the tides permitted. I also took the opinion of pilots and others, and afterwards attended a meeting at which Mr. Fishburn presided.

Circumstances obliging Mr. Drane to leave Whitby, I sent down Mr. Comrie, a surveyor of great experience, early in October, to complete the necessary surveys, plans, and sections; and during the same month I again visited Whitby, continued my survey, and took additional evidence respecting the harbour and river. After my survey a meeting of the trustees was held, at which the Marquis of Normanby presided, when I was interrogated on various points, and gave my opinion generally, so far as I then had the means of forming one.

I consider that I was thus in possession of the means for judging of the defects of the harbour, and reporting the remedies that appear to me best suited for lessening or removing them; and I proceeded to give these subjects my best consideration.

Having completed the draft of my plan and report, I went to Whitby again in December, when I explained my ideas generally to Mr. Pickernell, your engineer, and Mr. Clark, your harbour-master, and having discussed the various practical matters with them, I believe I may say that there is little or rather no difference of opinion between us in any matter of importance.

Previous to reporting my opinion, it will be proper to give a general description of the present state of the harbour and its entrance; for although these must be familiar to most of you, my report may have to be submitted to others, who have little or no personal acquaintance with Whitby.

Whitby is situated in latitude 54° 30′ north, and longitude 30′ west, 26 statute miles south-east of the river Tees, and 17 miles north of Scarborough, the two nearest harbours. The River Esk, of which Whitby Harbour may be considered the "mouth," is a very small stream in times of drought, but forming the drain of a hilly country which extends 16 miles into the interior, it sends down considerable floods during the rainy season. The tide which flows up the channel of the Esk to the tail of Ruswarp Mill, a length of two miles and a half, and fills the small bay or estuary opposite to the town, contributes in its return to assist the land floods in carrying out the sand, and in forming the entrance and the harbour. Of the two forces the land water is, as will be seen afterwards, by far the more important. The scour of the tidal water, taken separately, is of little or no account; its only value in this respect is as an auxiliary to the land floods.

To these operations of nature, the formation of the town and of the harbour of Whitby is no doubt owing; but they have been materially aided by the artificial works done at various times, particularly by the erection of the piers, which have guided and confined the land and tidal water out to low water at sea, and (to an extent) protected the shipping within them.

The bearing of the entrance of the harbour from the turning or swing bridge which divides the outer from the inner harbour (a length of half a mile) is north-north-east, one-third east by compass, or

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nearly true north. In this length there is a considerable curvature to the westward, and several projections, as shown upon the plan, which tend to break and reduce the range of sees in the harbour.

At the harbour's mouth the rise of tide is as follows: upon zero* of the gauge affixed to the quay below the bridge (which is one foot above the level of low water of spring tide)—

	Ft.	In.
Average of neap tides upon the gauge	11	0
Or from low water	12	0
Average of spring tides upon the gauge	16	0
Or from low water	17	0
Making therefore the depth of water upon the gauge at the average of spring and neap tides	13	6
Equinoctial spring tides ebb two feet under the average level of spring tides, and rise two feet higher, making a total flow or lift of .	21	0

On the days of full and change of the moon it is high water at half-past three o'clock. The best tide is the second day after, say at five o'clock. The tide is, as in most other places, influenced by the winds; north-west causing the best flow, and south-east the worst.

Outside the harbour is a flat bed of alum rock, called "Whitby Rock," and the Scar, extending upwards of half a nautic mile from the pier head. The current of tide is what is commonly known as "tide and half tide," that is, it runs to the south for two hours and a-half after it is high water at the harbour's mouth, and to the north for two hours and a-half after low water at the harbour's mouth, the greatest velocity being two miles and a-half per hour. Inside, or near the harbour's mouth, the first of the flood tide is directly into the harbour, the Scar being so high as to prevent a current along the coast; but when these are covered, it runs also to the eastward, towards Saltwick Nab, and continues in that direction until about an hour after high water, the greatest velocity being about half flood.

The "Scar" or "Whitby Rock" before referred to covers the whole area to the eastward of a line drawn *true* north, from the middle of the entrance; close to the piers the rock shows a little above low water, and the outer end of the east pier is founded on it. Immediately outside the entrance it falls in 100 yards to 6 feet under low water, and in the next half mile does not deepen to more than 10 feet under low water. A portion also of the rock near its outer end, which lies north-east of the harbour at half a mile distance, is dry at low water of low spring tides. Between the rocks and the shore is a space, over which the depth is from one to two feet greater than over the average of the rock outside it, and the surface is more regular. In fine weather this forms a passage for small vessels, called the Sledway. On the west and north sides of the rock there is a sudden drop along its edge to nearly twice the depth upon it, which depth still increases to the westward, where the bottom is clay, forming the roadstead with nine fathoms water, at less than a quarter of a mile from the west edge of the Scar.

It is evident that these rocks must render the harbour unapproachable for vessels of burthen from any point east of north-north-east, except at the high water of spring tides; but this disadvantage is, to a degree, counterbalanced by their breaking the heavy seas, with winds to the eastward of north-east, so that the harbour is partially protected except from winds between north-west by north and north-east, seven points only, to which it is quite open.

As the direction of the west pier is north-east, as much advantage has been taken of the rocks to protect the entrance as could be taken, consistently with the facility of ships entering. The north-north-east gales just clear them, and at the same time have a fair run between the piers: hence the greatest range into the harbour may be expected, and I believe is with north-north-east gales. With all winds to the eastward of north-east, although there may then be greater surf, there will be less *swell* and *range*. Again, whenever the wind gets to the westward of north-west by north, the seas (as may be inferred from inspecting the plan) get into a direction more along the land or across the entrance, and therefore tend less to cause *swell* or *run* in the harbour; but north-west winds are attended with another and more permanent evil, viz., agitating the sand upon the shore to the westward, and bringing it round the west pier into the harbour's mouth, there forming the bar.

These are therefore the two principal defects of Whitby Harbour; viz., the great range of sea into it during gales between north-west by north and north-east, and the collection of sand producing a bar between the pier heads with westerly winds.

The present formation of the entrance, which I am about to describe, does not appear the best for counteracting these evils.

The width between the piers is 280 feet at the bottom, and 300 feet at the top of the walls. The effect of so great a width is to admit the seas into the harbour and to add to the swell.

The west pier, in respect to its length and breadth, and as an engineering work, is one of the finest in the kingdom; the last addition to its length was about 40 years since, by Mr. Pickernell, grandfather of your present engineer. Its direction is, as has been stated, north-east, finishing with a bold circular head or funnel-mouth, the effect of which shape is increased by the head of the east pier being *retired*, as has been described. This form tends farther to admit the swell, which, after getting round the head, runs up the smooth inside surface of the north pier with great power, breaks over the Scotch Head with violence, and ranges round the end of it, up the harbour, and even through the bridge (although the four openings under it are altogether only 117 feet), to such an extent as to cause considerable swell in the inner harbour.

The direction of the east pier is north-north-west, forming an angle 67° 30′ with the west pier, which projects about 100 yards beyond the east pier. From this inequality in the length of the two piers arises another evil, viz., a difficulty to ships entering the harbour, through the eddy, between the termination of the west and that of the east pier, this space being out of the way of the fair *run* of flood tide. A ship caught in this eddy with a scant wind is apt to lose both her "way" and her "steerage" before she gets within the east pier, so that the action of the tide pressing her starboard quarter to the eastward, while the eddy is turning the larboard bow in the opposite direction, her *head* is brought round to the westward; she then drifts bodily to the eastward, and is in danger of either striking the east pier or of going upon the rocks behind it.

During my two first visits to Whitby, the weather was fine, and the bar, owing to the long drought was bad. Taking zero upon the tide-gauge, as being the low water, the sand was from three to four feet above this level for the western half of the width between the piers; the remainder was nearly dry at low water. The spit of sand extended out 100 yards in an easterly direction before it reached low water.

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* Zero upon the gauge is 22 feet under the ground-floor of the public Subscription Baths.

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In October, the fresh-water course near the pier heads was more tortuous. From the "Scotch Head" it shot off to the eastward, until nearing the east pier, when it crossed back to the west pier, and then turned again to the eastward, leaving a shorter spit against the west pier. In the level of the sand, or facility for ships entering, there was but little difference. I name these particulars to show the present uncertainty of the channel and its small depth, when it has been long without a land-fresh to scour it. It is evident that there was, at the above time, only 12 feet at spring and 8 feet at neap tides, excepting in the narrow and shifting fresh-water channel. A good river-flood would, it was stated, increase the velocity of the outgoing current near the entrance, from half a mile (its then speed) to upwards of three miles per hour, and would clear the sand down to the rock, giving 3 to 4 feet additional depth, or from 15 to 16 feet at spring tides, and from 12 to 13 feet at neap tides, which was the case when I saw it in December. This was partly owing to a late fresh in the river, but still more to the seas during six weeks of east winds, driving the sand up towards and round the "Scotch Head," where it was heaped up to a considerable height.

A ship drawing about 15 feet 6 inches got into the harbour about four years since, but this is a rare case; and it will be seen by the above figures that all circumstances had then conspired to place the entrance in the best condition.

Notwithstanding these disadvantages, Whitby has occasionally been most useful as a Harbour of Refuge, particularly during north-west gales. I was informed of one case in which 75 ships, and of another in which 60 ships had entered it for refuge in one tide. A considerable part of these would, it was supposed, have gone ashore had they not got into the harbour. Mr. Aaron Chapman, the present representative of Whitby in Parliament, is a native of the town, and formerly commanded ships upon this coast. Thus, and from having since frequently surveyed the coast as an Elder Brother of the Corporation of Trinity House, he is well acquainted with the port. He states, in his evidence before the Shipwreck Committee, the public importance of the harbour; in proof of which he names that he has seen from 30 to 100 vessels go out in one tide, and that he saw on one occasion 70 to 80 sail driven in by privateers.

These cases do not alter the facts as to the depth, but they prove the truth of the saying that "Any port in a storm;" and they show the importance, upon public grounds, of improving and preserving a harbour which is, from its position, a port of refuge for life and property, though by no means a perfect one.

I now proceed to state some of the interior matters to which my attention was directed, as affecting the harbour and its entrance.

The dam or weir that crosses the river at Ruswarp Mill is a complete *stop* to the flow of the tide, as it is only in very extreme cases that it reaches the top of the weir. As a good spring tide rises four feet below the weir, the tide must have flowed some distance higher up the Esk, before the mill was built, than it does now; and, if the weir were removed, the channel above it would gradually deepen, and the tide flow up as before. On the other hand, the river above the mill is narrow, with rising ground on each side; and when the land-freshes are coming down, the tide is prevented from going up. Such an erection as this weir, although proposed by the owner of the soil and the lord of the manor (which Colonel Cholmley, the proprietor of the mill is), would be objected to now, every encroachment within high-water mark that is injurious to the harbour being unlawful unless made by Act of Parliament; but, as the mill and the weir have stood as they are for 92 years, and are valuable, the removal, without Colonel Cholmley's consent, is, I presume, out of the question.

Other encroachments upon the tideway are more recent. Some of them can, I trust, be removed; or, if this cannot be, their increase may be prevented.

By the Whitby and Pickering Railway Act, a new straight channel was substituted for the old circular course of the river, about a mile above the town, to enable a straight line of railway to be made. This was proper, for the railway is a valuable addition to the town; but the new course being narrower at high water, as well as shorter than the old, the tidal receptacle has been excluded from the old channel by means of a dam. This exclusion does not appear to me at all necessary for the railway, while its tendency is injurious to the harbour; and, unless there is some stronger objection to the removal of the dam than I have discovered, I think it ought to be removed now, and the water again admitted to ebb and flow with the tide, by which 20,000 to 30,000 additional cubic yards of water would pass in and out of the harbour at each spring tide.

About half a mile below Ruswarp there is a ford across the river, made, as I was informed, under the Railway Act; as it is broken through by the current, so as to be useless, I hope there is no objection to its entire removal.

A little higher up the river is a natural obstruction, by which the water is kept up. As this, and whatever tends to prevent the free flow and ebb of the tide, injurious to the harbour, a jealous care for its preservation would be shown by attention to what may, taken separately, appear most trifling.

Another and greater evil is, that the sides of the river and of the harbour within high-water mark are used as the place of deposit for the ballast of ships and the rubbish of the town. Only the week before my October survey some offenders in this respect had been charged before the magistrates with throwing chalk, rubbish, and gravel upon the east shore of the river, opposite the "Batts," a mile above the town. The quantity upon the bank appeared to be considerable when I saw it, although a portion of it had been washed down into the stream, and was still visible. The case was proved, but the party let off on paying the costs of the information. Some years since, to throw the ballast within the high-water line was said to be the usual mode of disposing of it. At the present time a wharf is being formed for the Railway Company, between the present quay and Barker's quay, where there was formerly a considerable depth of water; I did not ascertain that permission had been granted for this. Now, although the formation of wharfs is useful for trade, yet I think that such an encroachment ought not to be made without a regular application, and that the permission, if granted, ought to be coupled with an obligation on the party to fill up behind his wharf with material taken from the river *between high and low water mark*, by which a double good would be effected, through the formation of wharfage and the deepening of the harbour, instead of using the ballast of ships for the purpose of backing. As the railway wharf required a channel up to it, this has been made, not at, I believe, the expense of the Company, but of the Commissioners, the material that was excavated being carried out to sea, in place of being applied to back the wharf.

It must be apparent that these gradual encroachments, although small in each month or year, must, in the course of time not only reduce the depth of the harbour, but also lessen the contents of the basin. And it is to be particularly observed that the scouring effect upon the channel, which depends mainly upon the *velocity* of the current, is lessened in a more rapid proportion than the quantity is. As

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there were no correct measurements by which to compare the present with former depths, I directed Mr. Drane and Mr. Comrie to take a number of cross sections of the river, from the entrance of the harbour up to the mill, to assist me in computing the area and quantity of backwater. A copy of these sections accompanies this Report. They are numbered from 1 to 36, and their place marked by dotted lines and corresponding numbers on the Plan A. These, with the correct plan I recommended, and which Mr. Pickernell has undertaken to make from a new survey, cannot fail to be very useful, if applied, to enable you to preserve and improve the harbour; and as the trade and value of property in Whitby depends so much upon the state of the harbour, no one having an interest in the town can be indifferent to the question. After the plan is finished, the limits of the harbour should be periodically surveyed, compared with the plan and sections, and the differences regularly reported on by your engineer.

As a means of preventing the evil I have just referred to, some ready and well-defined way should be taken of disposing of the ballast, which there is not at present. It might be landed and drawn up by engine power, as in the Tyne, or carted and shot over the east cliff, or put into boats with false bottoms, carried out to sea, and dropped to the eastward of the harbour.

The question is, which is the cheapest? The result of a calculation made by me, from premises furnished by Mr. Pickernell, was, that the disposal of ballast in the present injurious way costs more than if it were boated out to sea; if so, the compulsion to take it out would be no hardship upon any one. I strongly recommend that Mr. Pickernell be requested to well consider the subject, and report his opinion; this done, and the means recommended, any attempt to commit a nuisance in the harbour should be so noticed as to make it an example and warning to others. It is quite evident that if the harbour, even in its present state, is to be preserved, the ballast thrown into it must be taken out again, and thus there are two expenses, one of which would be rendered unnecessary if the proper course were adopted at first.

Another regular and almost authorized (at least not objected to) mode of disposing of the town rubbish is into the sea, on the west side of the battery, behind the west pier, whence it is washed down by the seas in north-west winds, and brought to and round the end of the pier into the harbour with the flood tide. The marks of this were visible upon the shore when I was at Whitby: it ought to be prevented; and when Mr. Pickernell shall have determined the place for it on the east side of the harbour, the west side may be effectually closed; but to attempt this without offering a substitute would be almost in vain.

I come now to state what appear to me the most certain means of improving the harbour, and to be essential for that important object.

They consist chiefly of—

1st. An improvement in the piers, to facilitate the entrance of ships into the harbour, and to lessen the swell or run within it.

2nd. Forming the inner harbour into an occasional back-water, for the removal of the bar.

First, as to the piers:—

Having stated that I consider the unequal length of the piers to be the principal cause of the danger and difficulty of entering the harbour, and the great width, with the formation of the end of the west pier, to be the causes of the heavy seas that enter it, the remedies that naturally present themselves are to extend the east pier as far out as the west pier, in reference to the line of coast and set of tide, and to give this additional length such a direction as at the same time to narrow the entrance; also to give the end of the west pier a shape which shall be less inviting for the seas to enter the harbour than the present funnel shape.

I beg now to refer you to plan B., which shows (from Mr. Comrie's survey), on a larger scale, the part of the river from the entrance of the harbour up to and including the bridge.

It will be seen that I have proposed an addition to the east pier, in a direction north-north-east quarter north, for a length of 220 feet, when there is a return of 15 feet to the westward, and the line is then bent a few degrees to the east of north-north-east for a length of 20 yards, this forming one side of the *throat of the entrance;* it is then rounded off with a radius of 30 feet to a sea face or front, square with its side, and by an addition to the present circular end of the west pier, the west, or opposite site of this "throat," is formed so as to correspond with, and be parellel to, the east side, giving a width of entrance of 150 feet at bottom, and 170 feet at top, (the average width being 160 feet,) and the west pier being rounded off to the same radius as the east. This general confirmation will be better understood from the plan.

I have been particular in stating the bearings and dimensions, that a correct opinion of my proposal may be formed by your harbour-master, and other practical men. My opinion is, that while the entrance will be sufficiently wide, the harbour will be rendered comparatively quiet, and the facility of entrance much increased; that there will be less disposition to eddy, and as its consequence, less deposition of sand; and that what sand does collect will have a better chance of being carried out clear of the heads by the outward current. Also that the extension of the east pier will prevent the sand from being driven into the harbour during easterly gales.

I am not aware that more can be done for the entrance without extending both heads out to sea, the cost of which would be very great.

If, however, the entrance were as perfect as art and science (without limit to expense) could make it, the dependence upon land floods for clearing away the accumulation of sand will always make it, not only a bar harbour, but an uncertain bar harbour, good after rains, bad after continued dry weather. For a harbour of importance for trade, and occasionally for refuge, this certainly is a bad character.

Having given this subject my attentive consideration, I think the most effectual remedy is, to place in the contracted part of the harbour, close below the bridge, a pair of wide gates in line with the bridge, opening for the passage of ships, and sluice gates on each side, so that by shutting all the gates at high water, when the bar is bad, and thus penning up the water in the inner harbour until nearly the time of low water, the sluices may then be opened, and the contents discharged through the outer harbour and upon the bar. As in ordinary spring tides a head of 14 feet over an area of 40 acres would be penned up to form a back-water, the power to clear the outer harbour and entrance would be so great as, I think, effectually to remove all sand from between the piers down to the rock, and even *below* the present level of the rock, should it be thought desirable to excavate it. The position of the gates and sluices here referred to is shown upon plan B., to which I request your attention. If the quantity were small, and the effect to be produced by the *velocity alone* of the water issuing from the sluices, the distance of the bridge to the bar being half a mile would be an objection; but I consider the effect in this case to be more nearly represented by the current of a river which is dependent for its effects upon its

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quantity, and upon the slope of its surface. If the quantity passing down the channel from the sluices be as *great* as that of the river Esk in a flood, the effect of the back-water in the same time will be similar, and the whole width from the sluices downwards as effectually scoured by it.* If a back-water is to be formed at all, this is, I think, the best mode of making it; and I do not anticipate any difference of opinion on this point by Mr. Pickernell, as he has now given it his matured consideration. It would be quite impossible to collect even a tenth of this quantity in the triangular space between the head of the east pier and the Herring-house, (Colliers' Hope,) while the walls for enclosing the space would render the penning of this smaller quantity more expensive than forming a pen at the bridge, where scarcely any walling would be required. Again, the enclosing so considerable a portion of Colliers' Hope might be objected to as confining the area over which the seas are spread, and partly expended after entering between the piers.

As the width of the *gates* and extent of *water-way*, by the plan, would be greater than under the bridge, the only inconvenience likely to be felt by the plan proposed by me, would be during the erection of the necessary apron and works.

I estimate the stonework of the piers, as described and recommended, at 30,000*l.*

The cost of the sluices and gates may be 15,000*l.*; but it is proper to state that this last sum is assumed from the magnitude of the work and my general experience. To estimate the cost correctly would require detailed drawings, which I have not prepared.

If, however, the whole of the works, including contingencies, be taken at 50,000*l.*, this sum ought not, I think, to be considered great in comparison with the public and private advantages that would result. And when the ports near you are being improved and enlarged, Whitby cannot be expected to maintain its trade and comparative importance if it be allowed to remain subject to its present disadvantages.

I was prepared with a recommendation for lessening the present inconvenient swell higher up the harbour by a work at the Scotch Head, but as I think it probable that the alteration of the piers will sufficiently effect this object, I strongly recommend that your attention and resources be, in the first place, confined to the measures I have described.

I have, &c.,

JAMES WALKER.

P.S.—My surveyors and myself have to acknowledge having had every assistance and information from Mr. Pickernell and Mr. Clarke, which it would be remis not to notice with thanks.

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No. 208.

Report by MR. F. PICKERNELL, ESQ., C.E., *on the Harbour of Whitby.*

MY LORDS AND GENTLEMEN, *Whitby, 4th March*, 1845.

HAVING received your commands to prepare for your consideration plans for the improvement of this harbour, I beg to lay before you herewith designs for additional works, which I humbly yet confidently think will have the desired effect.

The great evils complained of are,—1st. The accumulation of sand, forming a formidable bar between the west and east pier heads; 2ndly. The swell or sea that rolls into the harbour when the winds range from the north-west to the south-east; 3rdly. The difficulty of entrance, from the fear of vessels being driven behind the east pier, in consequence of its being so much within the line of the west pier head.

Having stated the causes of complaint, I will now proceed briefly to explain my ideas as to that which will be the means of curing the defects. I will therefore take into consideration the first-mentioned evil, viz., the bar. In strong N.W. winds, causing a bat or surf on the shore, together with the flood-tide setting along the shore from west to east, or more properly from north-west to south-east, strikes the west side of the west pier, and puts the sand in suspension, which, rushing round the pier head, falls into the eddies naturally caused by the pier being placed at right angles to the current of tide. I think that whatever may be the form of the piers at the entrance of the harbour, this evil can never be got rid of without a counteracting power, such as a strong natural breakwater, which there is not, or an artificial breakwater, which there is some difficulty in obtaining without objections, and that at a cost not compatible with the available funds.

I beg to call your attention to the proposed erection of a groyne, as laid down in the plan before you. It is proposed to commence the groyne about high water-mark of neap tides, taking a N. by E. ½ E. direction from the centre of the Battery, to 100 feet below low-water mark at ordinary spring tides. The length will be 825 feet, the breadth at the foundation of the north end 70 feet, at the top 12 feet; the breadth at the foundation of the south end 30 feet, at the top 8 feet. I think you will readily agree with me, that the groyne proposed will have precisely the same effect in checking the sand from travelling southward as the west pier has at present; and the groyne projecting further into the sea, any matter held in solution that does not fall into the eddy caused by the groyne will pass into deep water, by the action of the flood-tide setting eastward, as may be seen on reference to the plan. The space between the proposed north end of the groyne and the west pier head being in what may be termed still water, the *inset* of the tide will be more direct, being simply drawn into the harbour by the indraught of the estuary.

In the evidence given by Sir Henry De la Beche before the Commission on Harbours of Refuge, he says: "I apprehend that the silt or other small detritus, mechanically suspended in water by the motion of that water, or forced on the bottom by that current, must be deposited in all situations where the necessary motion to keep it suspended, or the friction to propel it onwards, ceases."

Having, I trust, made it appear that the erection of a groyne as proposed will prevent the sand from accumulating in so detrimental a manner as heretofore, I beg to proceed in considering what would be the best plan for abating the swell that rolls into the harbour in gales of wind from the sea.

In the year 1800, as shown from a plan belonging to the trustees (now in my possession), it was proposed by the late Mr. Jonathan Pickernell, the resident engineer for the time being, to carry out the east pier in a north-eastern direction. It therefore appears that it has been long thought that the extension of the east pier would be desirable. I have hitherto bad an objection to such extension, from the fear of its producing a greater deposit of sand on the bar, without other works being done concomitant therewith; that is to say, either counteracting power by means of sluices, or other means of keeping the bar clear of sand.

On the plan I have proposed to extend the east pier 300 feet; 250 feet in a straight line, the remaining 50 feet diverging a little to the eastward, and in such direction that, on the work being completed, the

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* The sluices, as shown upon the drawing, are calculated to discharge while the head continues a greater quantity than the land-flood of the river.

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entrance of the harbour will be 160 feet wide on the average, instead of 290 feet, as it is at present. Referring again to the plan, it will be seen that when gales of wind are blowing from the north-east (the wind that causes the heaviest sea in the harbour), the present entrance will just be half covered; it may therefore be fairly inferred that only half the sea will come into the harbour.

Any winds to the eastward of north-east will be comparatively harmless, as the extension of the east pier will shoot the heaviest of the sea to the westward of the east pier, thereby having the effect of warping the sand that will be deposited by the groyne into the space between it and the west pier. It cannot be denied that winds from the north-west to the north-east will after all cause considerable swell to enter the harbour's mouth, which will naturally hug itself up the extended part of the east pier and spread into Collier Hope. I would therefore not lose sight of the proposed extension of the Tate Hill Pier, as the more the swell can be confined to the lower part of the harbour certainly the better.

Little need be said as to the third evil or cause of complaint, viz., the difficulty of entrance from the east pier being so much within the west pier head, it being self-evident that when the east pier has been extended, there will be of course much less danger of vessels in taking the harbour being driven on the scar.

In a former plan I have given a design for a sluice, by means of penning about 3½ acres of Collier Hope, to form a basin, in order to scour the accumulation of sand when collected on the bar; but as the cost of a pent, in the most economical situation, would be four times the expense of the proposed groyne, in addition to taking up area in the harbour on the one hand, and interference with the navigation in any other situation but the one pointed out by me, as well as the consideration of the groyne being self-acting, and sluices at all times a cause of expense. Again, as "prevention is better than cure," I beg to repeat my recommendation of your adopting the groyne.

In the event of your taking a favourable view of my designs, I presume you will not think of carrying on the whole of the plan at once. I am therefore led most respectfully to recommend that you commence with the extension of the east pier, for the following essential reasons:—1st. It having been so long considered a desideratum with the great majority of nautical men. 2ndly. The certainty of quieting the swell in the harbour. 3rdly. The improving the facility of entrance; and again, should you adopt my suggestion of carrying on the work in sections, you can at a short period discontinue the work should the extension act detrimentally in causing a greater increase of sand on the bar, and then have recourse to the means of prevention I have recommended.

The depôt for the refuse material of the town, at the west end of the battery, is now a very serious evil, as a great portion of the lighter materials during and after a gale of wind is washed down on to the beach, and eventually comes on the bar. After the groyne has been carried out, the evil will have ceased, as the sea, or recoiling wave, will bring the greatest quantity to the west side of the groyne; or, admitting that some part may be carried into the space between the groyne and west pier, it must lie there, not being liable to be acted on by any current.

The deposit of sand, &c., at or about the Scotch Head, at this present time so much in the way of the navigation, has been in the first instance brought round the west pier head, and then driven up by the *set* of the flood tide, aided by the action of the waves in gales ranging from the north-east to the south-east. Should the whole of my plan be carried out, the accumulation of sand in question can no more take place, premising that there will be no more accumulation of sand at the entrance of the harbour.

I estimate the cost of extending the east pier, as proposed, to be 21,731*l.*; and the cost of the groyne, as laid down on the plan, to be 5133*l.*; the cost of the whole of the proposed works consequently will be 26,864*l.*

Should you consider to adopt my suggestion of commencing with the east pier, I beg to recommend that you do it in sections, say six; which will make each year's work, in round numbers, 3600*l.*, exclusive of casual works that may be required in the harbour.

I am, &c.,
FRAS. PICKERNELL.

To the Trustees of the Piers and Harbour of Whitby.

No. 209.

PORT OF SCARBOROUGH.

SCARBOROUGH.

No. 209.

Evidence taken on the 27th October, 1845.

Examining Commissioners—A. CHAPMAN, Esq., M P., and Captain WASHINGTON, R.N.

Present:—Sir JOHN V. JOHNSTONE, Bart.; JOHN WOODALL, Esq; JOHN BURY, Esq.; JOHN WHARTON, Esq.; JOHN APPLEBY, Esq.

Mr. JOHN COOK examined.—Has been for seven years secretary to the Scarborough Piers and Harbour Commissioners, under the 6 Vic. c. 40 (1843); there are 118 Commissioners, consisting of the mayor and four of the corporation; many of the clergy and gentry resident in the neighbourhood; among them 25 clergymen, about 9 sailors, and several shipowners; some of the Commissioners reside at a distance of 200 miles; not above 30 have qualified; 11 members form a quorum; there is a local committee of 15, of which 5 is a quorum; one annual general meeting of the Commissioners is held, when the accounts are produced; they are audited by members of the Board, and are printed for distribution but not published; when a vacancy occurs it is filled up by the Board; the minute and account books are regularly kept; the dues, rates, penalties, and bye-laws are publicly affixed; not half the dues are levied that are authorized by the Act. The late bill was opposed by the corporation of the borough, which increased the costs to 2,700*l.*

Parliamentary expenses, 2,700*l.*

Mr. JOHN APPLEBY, Town Clerk.—The corporation of the town claim to be lords of the soil to low water mark, and of the quays and property round the harbour; they have been in the receipt of 550*l.* a year, levied upon shipping, authorized by order in Council of James I, and confirmed by letters patent (without seal) in the reign of Charles I; this money was directed to be appropriated to building an outer pier and the maintenance of other piers; during the last 10 years the money has been applied to such repairs of the pier as were necessary.

Mr. HENRY FOWLER, Collector of Customs.—Has been 20 years treasurer to the piers Commissioners and vouches for the accuracy of the accounts returned; the whole income was about 3000*l.* a year, of which 2,400*l.* arose from a passing toll on coal; and 600*l.* from harbour dues, chiefly on coals; the expense of getting the late Act, owing to opposition, was 2,700*l.*; salaries amount to 147*l.* a year; and the remainder of the income about 2,800*l.* was expended on the piers and improving the harbour. There is no debt, but a sum of 4,900*l.* in the 3 per cent. consols, which is reserved to meet any casualties; the interest of it is applied to the harbour. Submits an abstract of receipt and expenditure for the last 30 years. The passing toll ceased last year; is of opinion that Scarborough is as much entitled to such a toll as the neighbouring ports of Whitby and Bridlington.

GEORGE APPLEYARD, Harbour-master.—Has been 50 years acquainted with the port and 10 years harbour-master; has commanded a vessel for 12 years out of the port in the coasting and Baltic trade. Is well acquainted with Whitby and Bridlington. He was appointed by the old corporation of the

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borough. Has no complaint to make of vessels throwing ballast over into the harbour, but does complain of the deposits on the shore below high water mark between the western piers and the Spa, and, close along shore, within the harbour also; wants power to restrain them; an excavation is going on at the Spa, the soil from which is thrown on the beach and in case of any sea it will wash into the harbour; has constantly to complain of lime, bricks, rubbish, and sand washing into the harbour. Since 1825 the corporation quay, built of stone, and the closing in of the plank stages, 40 feet in extent, have caused much uneasiness in the harbour, owing to the swell at high water having no beach to expend itself on. Mr. Tindall's timber wharf has been fronted and made solid. There are plenty of dolphins in the harbour for securing ships to, but those in the new harbour are out of repair; that in the outer harbour was rebuilt last year. The breakwater pier contains large masses of stone of the Bath oolite from the White Nab; it was built under Chapman, the engineer, with Barry as resident. The island pier is of great service; the old western pier was built in 1816; 20 years later Sir John Rennie was called upon to give a design for its improvement; the plan was generally approved of, but not carried out from want of funds. A more extended plan has been proposed, to run out a pier from Ramsdale Scar, and another to make a detached breakwater and a wet dock; witness is of opinion that a western pier is most wanting; south east winds are the worst, and cause a heavy swell, end the sea and current sweep all the sand round the bay, and bring it into the harbour. The outer harbour will take ships of 14 feet and they may lie perfectly smooth; last winter upwards of 60 sail were in it, and many vessels use it as a port of refuge.

The following is an abstract of vessels that have sought shelter since August 1836.

	Vessels.		Vessels.
Leaky	113	Damaged at sea	3
In a sinking state	9	Pumps choaked	3
Dismasted	42	Loss of leeboard	2
Damage of rudders	7	Bows stove in	4
Abandoned and picked up	2	Cargo on fire	1
Loss of sails	37	Found at sea, all sick	1
From collision	22	Loss of windlass	3
Loss of bowsprit	15	Cargo shifted	3
Steamers in want of coal	10	Got off the strand between Whitby Rock and Flamborough Head	20
Steamers disabled	1		
Loss of anchors and chains	37	Total vessels	335

or 37 vessels, annually in distress; besides 4123 that have taken shelter in stormy weather, exclusive of Scarborough ships, which will raise the average to 500 sail annually which have taken shelter in Scarborough piers during the last 9 years; this is independent of fishing vessels, of which 100 herring boats go out daily during the season.

Scarborough lies in the bight of the great bay from Whitby to Flamborough, and thus, owing to its position, it has afforded shelter to many; many vessels have gone on the beach to the south-westward of the pier and have got off; vessels may beach with safety if they run up at nearly high water. There is a tide light (red) hoisted when there are 12 feet water at pier end; there is no bar, no obstruction of any sort but the beach; the rise of tide on ordinary springs is 18 feet, in equinoctial springs 21 feet, and 12 feet at neaps. There is a self-registering tide gauge placed at the pier end, and a regular register of the tides is kept and forwarded to the Admiralty; it will shortly be accompanied by a register of the barometer end of the winds and weather. Has to complain of a single gas-lamp which is left burning all night on the New South Cliff, and might mislead ships.

A great deal of sand comes into the harbour, and is taken out at a heavy annual expense of 300*l.*; a western pier, placed as he has suggested, would remedy this, and shoot the current past the harbour's mouth; it would probably cost 10,000*l.* The island pier, built of large rubble stone, is in a dilapidated state: it is of great use, and might be rebuilt for about 1000*l.* During the last year the number of ships running into the harbour has increased from 800 to 1000 arrivals a-year. As many as 500 sail of fishermen frequent the port in the season. It is contemplated that the supply of fish for York and Hull will be landed here and sent by rail; and in summer by steam to London. It is feared that railroads will destroy the revenue of the port, and eventually a great part of the coasting trade of the kingdom. There are no published charts of the bay or plans of the harbour, and shipmasters complain much of the want of them. The life-boat is in good repair; it was built by private subscription, and is 30 feet long, which is a full size, or indeed too large; one great evil is that in the event of wreck there is no control over the men who man the life-boat, and oftentimes improper persons get into her; on one occasion she was upset, and drowned several persons, which he attributes to this cause. Witness has been out in her himself scores of times, and has saved lives as well as property.

William Weir, Lloyd's agent.—Is a sailor, and has sailed out of the port for 20 years. In case he had to run for a harbour, would not take Bridlington before Scarborough; Bridlington is on the wrong side of Flamborough Head for loaded colliers; ships lie under the Head in S.W. gales, and, if necessary, bear up for the Forth. Has known hundreds of vessels saved in Scarborough; only lately two came in and were repaired; there is every facility for repairs. Has known vessels wrecked in the immediate vicinity of the harbour; even in Mill Bay, and upon the Horse Rock. Is of opinion that shipowners are not properly represented at the Harbour Board, and many of the Commissioners have never seen Scarborough; yet is perfectly satisfied with the management of the port. Has known many vessels get on Filey Brig, and to become wrecks. A large buoy at its outer end is much wanting, similar to that recently placed at the end of Whitby Scar, which is a great benefit to shipping. Only last Thursday a vessel from Lisbon struck on Filey Brig; and recently a vessel, called *The Aid*, belonging to himself, ran ashore on the Salt Scar on the east side of the Tees. The whole trade of the coal ports passes within two or three miles of Scarborough Rock, and 400 sail have been known to pass in one day; thus the shelter of its harbour is ready at the most convenient spot.

Mr. J. Woodall was present on one occasion when out of 400 vessels that bore up just to the northward of Scarborough Rock, the wind having suddenly shifted to the northward, apparently a cloud of them, 117 in number, came into Scarborough Harbour, and not 20*l.* worth of damages was done, showing the value of such shelter ready at hand. Up till this time the trade has increased, but fears that the railroads, by carrying coal at so low a rate, will much injure all harbours; generally speaking, the more harbours are improved the greater the traffic; considering the number of sailors brought up

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between the Tyne and Flamborough Head, it is very important that this our best nursery for seamen should be protected, and not be permitted to be destroyed by the competition of railroads, which have no harbour or light dues to pay.

Mr. HESP.—Under former Acts the accounts were annually exhibited at the sessions, not published; much money has been wasted on law expenses that ought to have been spent on the harbour; an action against Messrs. Tindal cost a large sum of money; the cost of the last Act, owing to opposition, was 2700*l*., nearly enough to have built the west pier. A proposition was made by the corporation to build the west pier, but they refused to apply their funds to this purpose unless the Commissioners would begin it at once; at a conference which took place, the Commissioners were ready to pledge themselves to build, but then the corporation declined. As far back as 1806, Roger Nixon, the sub-engineer, proposed a somewhat similar plan for the west pier as is now suggested by the harbour master.

WILLIAM APPLEBY.—Pilot and fisherman for 37 years; is acquainted with the port and with the fishing-banks outside, which lie from 12 to 15 miles off the coast; this is the most convenient place for landing fish, as they can now be sent by railroad to York, and thus to all parts of the country; never the least difficulty in landing fish, and in summer a large fleet of fishing vessels come here, particularly in S.W. winds, when they cannot reach Hull. Here are no branch pilots; there is no difficulty in bringing a ship into the harbour; the dolphins are not in good repair; the great want is a west pier to stop the current from bringing the sand into the harbour, and throw it off past the harbour's mouth; thinks a pier on Ramsdale Scar would be the best; one was formerly begun there, but it was taken away; it was considered that it would have spoilt the sands; has known the harbour to afford shelter to many vessels in distress, and 11 ships ashore on the sands, which a west pier would have prevented; no vessels receives damage on the sands.

THOMAS FITZWILLIAM and THOMAS LILLEY, fishermen.—Agree in all that Appleby has stated; are quite sure that this is the best place along the coast for landing fish; and nothing is wanting but a west pier to make Scarborough a secure and snug little harbour, and in their opinion better than either Bridlington or Whitby.

No. 210.

Report of Sir JOHN RENNIE, *on the Improvement of Scarborough Harbour.*

No. 210.

Rennie, on the Improvement of the Harbour, 1834.

GENTLEMEN, *London*, 26*th September*, 1834.

In consequence of your having requested me, by your resolution of the 7th of January last, to examine the Harbour of Scarborough, and report my opinion,

First.—As to its present state, and the plans which may be the most advisable under all the circumstances, in order to provide a remedy against the present evils.

Secondly.—To point out what additional works may be necessary, in order to provide better and more accommodation, not only for the present local trade and for those vessels which frequent the harbour as an asylum during storms, but for such an increase of trade as may be reasonably expected from making Scarborough a place for import and export for the raw materials and manufactures to and from the manufacturing district of the west Riding of Yorkshire and the Continent.

Viewed in this extended light, the subject is of great importance, and is worthy of a corresponding degree of consideration.

Upon looking over various papers connected with the port in your possession, I was sorry to find that there was no complete plan and chart of the present harbour, or of the bay and adjoining headlands, which were indispensable in order to enable me to form a correct opinion on the subject. I accordingly directed Mr. Coombe, one of my assistants, to proceed to Scarborough, in the month of March last, during the period of the equinoctial tides and gales, in order to prepare the necessary documents which are contained in the accompanying plans, numbered 1, 2, 3, 4, and 5.

The extensive nature of those surveys necessarily occupied some time, so that from various causes I have not been able to send the result of my observations until the present, which I trust you will excuse. I now therefore beg leave to submit the following remarks, classed under their respective heads, in order to explain the subject more clearly.

First.—The general extent—survey and capabilities of the bay—headlands—soundings—currents and winds.

Secondly.—The present harbour—its extent and defects, and the best mode of improving it—together with the estimate of the expense.

Thirdly.—The most advisable plan for extending the harbour, both as a tide and low-water harbour, together with the respective estimates.

With regard to the first. The bay of Scarborough, taken between the outermost point of the Castle Headland and Nipe Point, is two and a-half miles wide and three-quarters of a-mile deep, when taken from a straight line drawn between the above points; if taken, however, between Flamborough Head, which is the extreme southern headland, and the Castle Point, it is 18 miles wide and 1 mile deep.

The shores, generally speaking, are bold and abrupt on all sides to high-water mark, being composed of cliffs of sandstone, varying from 50 to 150 feet in height; from thence to low water the shores are flat, and ebb dry to a considerable distance. Towards the north-west end of the bay there are extensive sands, which, at low water, are bare for about 900 feet beyond high-water mark, and three-quarters of a mile wide to the southward: they form a fine situation for bathing, and for the waves to expend themselves upon. From thence to the southward the shores are flat and rocky; and diminish in width until they unite with the bold perpendicular cliffs of Flamborough Head. The bay, for the most part, is clear of rocks beyond the line of low water, except the rock called Ramsdale Scar, situate about 1000 feet to the south of the present harbour, and projecting out 1100 feet at right angles to the shore, from low water of good spring tides, when there is little more that 12 feet upon its outer end: this rock forms a kind of natural breakwater against the southerly seas to the present harbour, although not sufficiently high to be effectual. The rest of the bay is clear of rocks, and affords good anchorage with the wind off-shore from south by east to north-north-west, or about half of the compass.

The soundings, taken in a line between the two headlands above mentioned, vary from five to six fathoms at low water, decreasing from thence gradually towards the shore.

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Rennie, on the Improvement of the Harbour, 1834.

The bay is exposed direct to the east, and may be termed open from north to south-east, or twelve points of the compass.

Gales from either of the above quarters send a very heavy sea into the bay, but the most severe come from north-east to east; during which period the bay becomes dangerous and unsafe for anchorage, and frequent instances of shipwreck have occurred.

The main current of the flood tide in the offing sets from the northward, and when at the strongest runs at the rate of two and three quarter miles per hour, and *vice versâ*.

The main current of the ebb sets from the southward, at two and a-quarter miles per hour, continuing nearly six hours each way.

The counter or eddy current commences close in-shore near the Spa, one hour before high water, setting to the northward, and continues in the same direction until two hours after low water, or nine hours; and during the remaining three hours it is barely perceptible: but when it blows strong from the south to south-east, it sets almost continually to the northward, passing close to the pier heads of the present harbour, at the rate of one and a-quarter mile per hour: at this time the sands at the north end of the bay are chiefly in motion, and occasion inconvenience.

Spring tides rise 18 feet 6 inches; neaps 7 to 9 feet; and equinoctial tides, 20 feet. These, however, are much influenced by particular winds; such as a strong northerly wind, succeeded suddenly by a southerly one, which occasions the highest tides, and with them a heavy sea.

Such is the local description of the Bay of Scarborough, from which it appears that it possesses considerable capabilities for a good port; but when it is considered, that it is one of the finest bays between the Thames and the Tyne, and most convenient for vessels overtaken by north-easterly gales between Flamborough Head and the Tees, in their passage northward, or *vice versâ* by a south easterly gale on their voyage to the southward, it becomes of great value as a port of refuge, and every endeavour should be used to render it as complete as practicable.

With regard to the second. From the peculiar advantages afforded by the Bay of Scarborough, as more particularly described in the first article, it appears that as far back as the reign of Henry the Third it was selected as a proper station for constructing a port of refuge, and "in the 36th year of the reign of that monarch, viz., on the 30th July, 1252, particular duties were granted for the benefit of the town of Scardebourgh, to make a certain new port with timber and stone towards the sea, whereby all ships arriving there may enter and sail without danger." And in 1546, and in subsequent periods, various aids and duties were granted by Parliament, and continued for the benefit of the port: these duties were both local and general, but the chief portion was derived from duties on coals shipped from Newcastle, and which were granted in 1605, at the request of the shipowners of various ports from Sandwich to Newcastle inclusive, for the purpose of forming and maintaining a port of refuge for vessels imbayed on the coast.

The harbour (which is situated at the northern extremity of the bay, at the base of the bold projecting promontory called the Castle-hill, with the town of Scarborough rising immediately above it) was originally commenced by the erection of the present Old Eastern pier, at the bottom of the Castle-foot rocks, extending in a south-west direction 550 feet; this it appears was lengthened about the close of the 17th century, in the same direction, to 750 feet, or immediately opposite the east end of the present Island Pier.

In 1752, the old eastern pier was again extended three hundred feet, by Mr. Vincent, making in all one thousand and fifty feet, and then terminating in a depth of from eight to ten feet at low water:—previous to this, however, in the year 1732, the new outer pier was commenced, in order to give more protection to the inner old pier, and has been subsequently continued until the present period, when it extends one thousand four hundred feet in a south-west direction, and terminates one hundred feet beyond Vincent's Pier. The depth here was originally twelve feet at low water, but, in consequence of the accumulation of sand brought on by the inshore currents or northerly eddies, has decreased to two feet. The accumulation of sand increased continually in the interior of the harbour until 1825, when it was thought advisable to construct the present western pier, in order that the inrun of sand and sea might be checked, and that the constant efflux and influx of the tide through a smaller entrance might be better able to preserve the depth within the harbour.

The effect produced by this west pier has been considered beneficial on the whole, although from the peculiar formation of the bay, and the sets of winds and tides, a certain degree of accumulation of sand within the piers might have been anticipated, and still does take place; nevertheless, this is considered a minor evil under the circumstances, and may be removed at less expense than before. The advantages of protection, and the facility of carrying on trade, have also been increased by the alterations.

Various other alterations and additions have subsequently taken place in the interior and exterior of the harbour, by means of detached breakwaters, mooring posts, jetties, and in the pier heads, without interfering with the general principle of the harbour, as above described, until the present time; when the increased and continually increasing resort of vessels to the port, renders a corresponding increase and improvement in the accommodation of the harbour necessary.

The harbour of Scarborough therefore, in its present state, may be properly described as shown in the accompanying chart, to consist of three piers, namely, two eastern piers, and one western pier, forming together an outer and inner harbour, having the entrances of both pointing to the south; the former being sixty feet wide, and having a depth of two feet at low water of spring tides, at the pier head. The latter having a double entrance formed by a detached pier, or island pier, one hundred and sixty feet long in the middle; and an entrance of one hundred feet wide at the west end, and sixty-seven feet wide at the east end, and four feet six inches above low water of spring tides.

The outer harbour is one thousand one hundred feet long and two hundred and seventy-five feet wide at the broadest part, and contains about five and a quarter acres; but, from the great accumulation of sand in it, and the difficulty of the entrance, it is rarely or ever used, which is much to be regretted.

The inner harbour is four hundred and seventy feet long, taken from the inside of the island pier in a direct line to the shore, and one thousand one hundred and thirty feet wide at the north or shore end; three hundred and thirty feet wide between the outer end of the west pier and the inside of the east pier; and, taken within the above limits, may be said to contain about nine acres; having at high water of spring tides fourteen feet six inches at the entrance, and nine feet at neaps; and at extraordinary tides from sixteen to seventeen feet. It cannot therefore, under any circumstances, be termed accessible for vessels drawing more than eight feet of water, until two-thirds flood at a medium tide, one-half flood at an equinoctial, and high water at a low neap tide; so that vessels drawing more water must either wait until a later period of the tide, or, if it happens at neaps, must seek refuge else-

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where; but, as it frequently occurs, that the heaviest sea sets in with the flood tide, and vessels seeking shelter crowd one after another in fleets, by the time that they reach the harbour, (if there is sufficient water to enable them to enter,) great confusion and frequent accidents take place; and the harbour, even when full, cannot accommodate above fifty or sixty square-rigged vessels, which is far too little; and those which cannot find entrance must trust to their anchors and cables outside, or keep to sea at great risk of being wrecked, which unfortunately too often happens.

The difficulty of entrance, and the want of accommodation, and confusion resulting from such a confined space, are very considerable; and only serve to illustrate more forcibly the desire and almost necessity of vessels resorting here, rather than run the risk of shipwreck by remaining at sea, or by being driven elsewhere. The present harbour, in addition to its already too confined space, has been much further restricted by encroachments of quay-walls and other works made by the Corporation and private individuals, which not only occupy that space which would otherwise be used by vessels, (and for which accommodation, having been taxed, they have an undoubted right to possess;) but, from the injudicious construction of the works themselves, the agitation within the harbour is considerably increased, and thus not only injury is occasioned to vessels resorting there for protection, but the space occupied by them, amounting in surface to three quarters of an acre, or one twelfth of the inner harbour, is taken away, and one-fortieth of the whole tidal water during a medium tide is lost; which forms the chief means provided by nature to keep it open.

The accumulation of sand from the northerly outset of the counter or eddy current, bringing with it the deposits from the upper end of the bay and the adjoining shores, is, as might naturally have been expected, considerable; and various measures, such as making openings in the outer piers to keep up the circulation of the tide, have been attempted without success; and the plan of removing it artificially by means of excavation, has been resorted to, as the best means of insuring a sufficient depth.

The quantity of deposit removed annually in this mode, and carried away by lighters, amounts to seven thousand and twenty tons, at the cost of 180*l.* per annum, and in this respect the harbour has seldom or ever been known to be in a better state than at present.

The construction of the piers and their accompanying works, (considering their early origin and the progressive state in which they have been carried on, through a succession of nearly six centuries,) are, as may be naturally conceived, of a rude description as to design and workmanship, although corresponding with the knowledge of the period; and, with occasional repairs incidental to such structures, they have withstood the destructive efforts of the sea; notwithstanding, however, the harbour cannot by any means be termed complete, or such as the local trade or an asylum (for which it was originally instituted) requires. The defects therefore of the present harbour, from what has been said above, may be briefly summed up under the following heads:—

1. Difficulty of entrance, and want of tranquillity during storms.

These in any case, but particularly in an asylum harbour, form most important objections.

2. Deficiency in depth of water.

This is very objectionable both with reference to a tidal and low water harbour, inasmuch as it prevents them from being used at the time they are most required.

3. Want of space.

This is objectionable, inasmuch as it reduces the accommodation for those vessels which find entrance during storms; so that others which make for the harbour, where there is no accommodation for them, frequently receive much injury.

Having described above, the capabilities of the bay and harbour of Scarborough in its present state, together with its defects, I will now proceed to point out what, under all the circumstances, appear to be the most advisable plans for remedying them; and of giving such increased facilities to the port as the increasing trade on the coast, or any extension which may be contemplated in this part of Yorkshire require.

With regard to the third. The first object should be to direct our attention towards finding a remedy for the evils of the old harbour, as above described in article second. Among the chief of these objections are the confined and difficult nature of the entrance and the interior of the harbour, and want of tranquillity and depth of water, in consequence of which when a fleet of vessels are making for the harbour, (which not unfrequently, or rather usually occurs when taken aback by a north-east gale,) they crowd so fast upon each other that they ground in the entrance and almost block it up entirely, and thus prevent for a time, until the tide has risen sufficiently, others from entering: but, if under these circumstances they happen to have approached too near before they are aware of the above state of things, they have no alternative but either to drive against those in front and thus create confusion and damage, which it is difficult to prevent; or they run the risk of being wrecked in port, where they ought to find shelter; or else they are compelled to keep at sea with an equal chance of being driven on shore near the Spa, and wrecked or foundered in the bay, of which there are unfortunately too many examples on this coast, similar to that which occurred in the tremendous easterly gale of 1824.

The above remarks must not be considered as applying to any natural defect in the bay itself, but to the defects of the present harbour, which, (although with the exceptions above-mentioned may answer for an ordinary tide harbour, upon a small scale,) is nevertheless by no means adequate for that of a public asylum harbour, such as Scarborough was intended and ought to be. In addition, moreover, to the above objections,—(I do not include the outer harbour, because it is so filled up with sand, and the entrance is so narrow that it is seldom or ever used,)—the entrance is so situated that the northerly counter current, increased as it is invariably during south-easterly gales, sets directly past it, and sends a heavy sea into the harbour, together with the sand which it holds in suspension, and thus produces a constant swell, and causes vessels to strike against the ground and each other with considerable violence; whilst at the same time the accumulation of the sand within, and consequently the expense of its removal, is materially increased.

To obviate these serious objections I would propose,—

1. To remove the island pier entirely, which only serves to confine and agitate the entrance without producing a corresponding degree of protection within.

2. To prolong the west pier four hundred feet, so that its head or outer extremity may terminate just within the head of the present outer pier; and to construct a jetty at right angles to it, at about eighty feet from its extremity.

3. To construct another jetty of the same dimensions, and in a corresponding situation, on the inside of the present outer or eastern pier; leaving a clear entrance between the two jetties of one hundred and fifty feet, and between the two pier heads of two hundred and fifty feet. And,

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4. To shorten and remove about three hundred feet of the outer end of the present Vincent's pier; and to make an opening of about fifty feet wide near the upper end of it, so as to allow the tide to circulate freely through it. And to transfer the lighthouse to the outer end of the west pier, when prolonged as proposed.

The effect of the above alterations and additions, which are more particularly described in design numbered one, would be as follows:—

By the removal of the island pier, and the shortening of Vincent's pier, the harbour would be considerably enlarged in its most important part, viz. the entrance. The tide also, both in entering and departing from the harbour, would experience less obstruction, and circulate more freely, and consequently tend to lessen the deposit of sand. The prolongation of the western pier and the construction of the two jetties would give an accession of one acre to the interior of the harbour, or an increase of one-ninth of its present size; and the inrun of the sea, which now produces so much mischief, would be prevented; whether brought in by the counter current or by the direct force of the wind. And the additional size of the entrance, (being twice that of the present,) and its peculiar form, would give great facility of access and departure; so that vessels making for it, when there might be sufficient water, whether singly or in fleets, would produce no confusion, but would reach their births without difficulty, and when there would remain in safety. The indraught into and out of the harbour, both upon the flood and ebb, would be stronger, and consequently tend to preserve its depth better; and the present outer harbour, which is now of comparatively little use, would be rendered available for the accommodation of thirty additional sail of square-rigged vessels, which would be a most important acquisition. I have said, by the above arrangement the accumulation of sand within would be diminished, but I do not, however, mean to contend that the evil can be wholly removed; because, from the very nature of such an harbour on such a coast, it is almost impracticable to obtain perfectly safe and tranquil accommodation for vessels, without the inconvenience of an accumulation of deposit to a certain extent: but this, from your past experience, only amounts to 180*l.* per annum, and will be reduced under the proposed alterations. This sum, however, is moderate, compared with the immense advantage of affording a safe and convenient asylum to so many vessels, and the preservation of numerous valuable lives during storms.

The expense of the above alterations and additions will amount to the sum of 14,500*l.*

The harbour of Scarborough, when improved as above recommended, would possess very superior advantages over the present; and, as far as a small tide harbour is concerned, would be one of the most efficient between the Thames and the Tyne.

Having pointed out what appears the most advisable plan for remedying the defects of the old harbour, I will now proceed to suggest a plan for its enlargement, still confining it to a tide harbour.

The most convenient and advisable arrangement for this, would be to extend it to the westward, by erecting an entire new pier from near Bland's Cliff, or about two hundred and eighty yards to the westward of the present west pier, and to make it terminate opposite to the present outer or easternmost pier; with jetties in a similar manner to that described for plan numbered 1.

This pier would give an increase of thirteen acres to the old harbour, making together twenty-seven acres for the whole, and enable it to contain eighty additional ships: and, if a wet dock should be required, (which would certainly form a very great convenience to the port); such a dock, containing five and a half acres, might be constructed on the east side of the above-mentioned new west pier, or between the outer eastern pier and that which is commonly called the old quay. The former, however, would I am inclined to think be found preferable, because the foundation is better; and the situation is more convenient, and better adapted to unite with any improved mode of conveyance, by railway or otherwise, which may be in contemplation, to increase the communication and consequent facility of import and export between the manufacturing districts of the west riding and the intermediate populous and flourishing country, and the port of Scarborough, and the continent.

The expense of the new west pier and entrance, which is more particularly described in the plan numbered 2, will amount to 26,507*l.*, and if the dry dock be added, to 54,465*l.*

The harbour, enlarged and improved as above described, would be sufficient not only to accommodate the present trade, but any reasonable increase that may be anticipated; it would still, however, be only a tide harbour, and as such would be liable to all the inconveniences of entering and departing, subject to the tide and the risks and delays arising therefrom; and could never be termed complete for all the various purposes of trade and an asylum for vessels in distress.

The next point therefore to be considered is—what is the best plan for obviating the above-mentioned inconveniences. The remedy no doubt, is by constructing an effective outer low water harbour or roadstead, having a sufficient depth of water to enable vessels to enter and depart at all times of tide; and when moored, to lie in perfect safety.

By considering attentively the resources of the bay, this fortunately is not of very difficult accomplishment, inasmuch as the shoal called Ramsdale Scar, (projecting out at right angles to the shore, between the Spa and the Mill-stream,) offers a good position for a work of this description. I would therefore propose to construct a detached breakwater upon it, as drawn on the accompanying plan marked No. 3, having its inner end to terminate about two hundred yards from low water mark, and its outer end in a depth of fifteen feet at low water of spring tides.

The total length of this breakwater would be about one thousand five hundred feet, consisting of three or four kants or arms, (as circumstances might render advisable,) inclined properly to each other so as to break off the sea, and to make a short addition to the outer end of the new eastern Quay, leaving an entrance of about two hundred feet between them. These two works would be for the most part constructed in a rough although substantial style with the exception of the two outer arms composing the sea entrance, and need not extend much above high water mark: because the principal object of this detached breakwater would not be so much for landing and embarking goods, as to afford an asylum within, and to break off the sea.

By means of this breakwater and its accompanying addition to the present east pier, the whole interior or tidal harbour would be protected; and the space between them would be converted into a capacious wet basin of sixteen acres; having from three to fifteen feet at low water of spring tides, and would accommodate seventy or eighty sail of large vessels, so that they might run for it at all times; and, if desirous of entering the inner tide harbour, they might do so whenever there might be sufficient water to admit them; or, if not, they might remain, and proceed to sea whenever the wind and weather might be favourable.

By having the breakwater detached, the counter currents would not be interfered with, and thus a

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continual circulation would be kept up through the entrance, which would tend to deepen and maintain the depth of the roadstead.

The sands also, which are so valuable to the town as the resort for invalids and bathing, would be preserved unmolested, and all the advantages of a tide and low water asylum harbour would be obtained.

Scarborough, thus improved and enlarged, would form one of the finest ports on the east coast of England, and would be the means of saving an immense number of valuable ships and lives which are now annually sacrificed, for the want of a safe low-water harbour to run for during gales of wind from the northward and eastward.

The estimate which would be required to carry this important work of the outer harbour into effect would amount to 94,041*l*.

This sum, however, when the important object to be obtained is considered, is not large; and, in the event of the shipping refusing to acquiesce in any trifling increase in their present passing tolls, (which, when the subject is fairly explained, might not be objected to,) might be raised by moderate tonnage dues on those vessels only which might take the benefit of it.

Considering all these circumstances, however, I should strongly recommend, if funds can be found, that every exertion should be made to carry it into effect; for I am convinced that in a very few years it would repay itself by the saving to the shipping interest, independent of the more valuable consideration of human life.

This plan might be extended further at a proportionable increase of expense, if found advisable, to twenty feet, or even a greater depth, at low water.

Having now, I trust, fully considered the subject in all its bearings, whether as regards its capabilities as a port,—the defects of the present tide-harbour,—and the remedy for them:—also with a view to enlarge it and adding a wet dock, still preserving it as a tide-harbour:—and lastly, as a low-water asylum-harbour:—together with furnishing plans, with the respective costs of each:—I have nothing further to add, but to state, that, as the plans above proposed contain the general outline and principle upon which any improvement should be conducted, it is probable, that when the detailed drawings are made out, several other improvements, without interfering with the principle above laid down, will suggest themselves.

With regard to the estimates, they have been founded upon the information obtained upon the spot, which, no doubt, Mr. Barry, or any respectable contractor will confirm; I now therefore beg to conclude, and cannot omit stating the valuable information which I have received from perusing the reports and other documents of your late able and ingenious chief engineer, Mr. William Chapman, and from your present zealous resident engineer, Mr. Barry, and his son, to whom I am much indebted for the assistance which they have invariably afforded me throughout this investigation.

I am, &c.,
John Rennie.

No. 211.

Sir John Rennie's *Second Report on the Improvement of Scarborough Harbour.*

No. 211.

Rennie's Second Report on the Improvement of the Harbour, 1835.

Gentlemen, *London*, 22*nd August*, 1835.

In consequence of your resolution of the 9th April last, requesting me to consider how far it might be practicable and expedient to enlarge sufficiently the Old Harbour by the construction of a new Western Pier, at the same time to increase the facility of entering and departing from the Harbour, particularly during storms, I proceeded to Scarborough on the 7th of April last, and after mature consideration, beg leave to report as follows; and here it may be proper to observe, that in my report of September last, I was not aware that it would be permitted to encroach so much upon the public sands, otherwise I should have suggested a plan for the above purpose; as it appears, however, that this encroachment would not be objectionable, if not carried beyond a certain point, the difficulty of proposing an efficient plan is much reduced.

The principal objections to the harbour in its present state arise:

First.—From its confined space and want of depth of water.

Secondly.—From the difficulty of entering and departing.

With regard to the first.—The present old harbour only occupies about 9 acres, independently of the outer harbour, but which cannot be termed of any use in its present state; because it is filled with sand, and the access to it is extremely difficult. Of the above space of 9 acres at spring tides, there is only a depth of 14 feet 6 inches, at the entrance, and at neap only 9 feet; so that in the former case, it can only accommodate about 50 sail of light colliers, or other similar vessels, besides fishing boats, and in the latter only 20 sail, which is far too limited for the wants of the trade; and consequently a great number of vessels dare not venture to take the harbour at all for fear of not finding accommodation, and are thus compelled to keep the sea under very disadvantageous circumstances, and frequently run imminent risk of being wrecked; of which numerous examples unfortunately occur: and even under the most favourable circumstances, when there is plenty of room, light vessels cannot enter before half flood; and if, as it too frequently happens, they should be taken aback with a N.E. wind, at low water when off the port, they must either be driven ashore, or else run almost equal risk of foundering by being compelled to keep the sea until the tide is flowed sufficiently to enable them to enter the harbour.

With regard to the second.—With all winds to the north of east, (which are the most dangerous,) vessels in trying to enter the harbour, generally keep close to the Castle Rock and the new outer pier along which at such times there ranges a very heavy sea; and then as they approach the pier head, they are met by the out-setting current from the bay, which renders it very difficult for them to effect an entrance; the more so, as they are compelled to bear up almost directly against the wind, or failing in this, they have no alternative but to run ashore below the Spa. Again in departing from the harbour, they cannot leave until high water, by which time (if proceeding to the southward) the whole of the flood current (which is favourable for them) is expended: and if in addition to this, the wind should be southerly, they cannot venture to proceed on their voyage; and at neap tides, large vessels if heavily laden, are frequently detained for a considerable period, losing both their voyage and market for their cargoes.

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To obviate all these evils, (of which the trade now so justly complains) the best and most advisable plan would be to construct a western pier; and as the principal objection to making such a pier of sufficient extent has now been removed, by permission being given to encroach in some measure on the sands, as far as King Street Steps, the facility of constructing an efficient western pier and of making the harbour sufficiently spacious is now obtained. I will therefore proceed to describe what plan, under all the circumstances appears best adapted to meet the different objects in view, viz:—to make a harbour easy of entrance and departure, safe and commodious within, and having a sufficient depth of water at the mouth, so as to enable vessels of the class which usually navigate the German Ocean, to enter when heavily laden with the first of the flood, and take shelter without fear of being neaped.

The plan which accompanies this report will describe more clearly what I would recommend, by this it is proposed that the New West Pier should commence at, or near King Street Steps, and be continued out in a S.E by E. direction to the shore, for a distance of 270 yards, it should then incline to the E by S. and making an angle of 158 degrees with the first arm of the pier, and be continued in this direction for 227 yards further, or until it arrives immediately opposite to the present termination of the outer East Pier. Here I should propose to make a rant or return head 200 feet long, to correspond with the outer end of the East Pier above mentioned, leaving a clear opening of 200 feet between them for an entrance; it may also perhaps hereafter be considered advisable, to extend the New Pier 200 feet further on the same direction, as the second rant or arm, and then to finish it with a circular head and lighthouse, and to make a corresponding addition to the East Pier, in order to prevent the run of the sea from disturbing the entrance, this however is a matter of future consideration, and may be deferred for the present. I have, therefore, merely shewn these last-mentioned works on the plan, in order to exhibit the whole extent of the design when complete.

The operation of these two advanced heads, if they should be required, would be to check the cross range and in-run of the sea into the harbour, and enable vessels to enter and depart with much greater facility; and as there would be generally from 10 to 12 feet at low water of spring tides alongside of these two jetties, the London steam boats and other large vessels, might almost always come alongside in moderate weather, and load and embark their goods and passengers with considerable advantage to the port and town of Scarborough. The harbour, when improved, by the addition of the West Pier as above recommended, would contain 34 acres at high water, and would accommodate 170 vessels in perfect shelter, from 50 to 350 tons burthen; and as there would generally be from 7 to 8 feet at low water of spring tides within the jetty heads, (because the current into and out of the harbour would maintain that depth) so that light vessels could nearly enter at all times of tide, and loaded vessels would come in during the first quarter of flood: the same advantage would arise when leaving the harbour. There would also be sufficient space for constructing a floating dock within, when required.

A spacious walk or promenade could readily be constructed on the new pier, raised sufficiently high, so as not to interfere with the working part of it; this would add greatly to the convenience and comfort of the town and to the visitors of Scarborough, and would at the same time be useful to the shipping; and although the sands would be in some measure encroached upon, this would be more than amply compensated for, and the sands would probably in a very short time be prolonged in an equivalent degree, over the flat shore to the southward of the new pier.

The expense of constructing the new western pier and inner jetty, independently of the outer jetties, which can be added hereafter, would amount to the sum of 49,280*l.*

After the completion of the New West Pier, the Old Island Pier should be removed, and the present lighthouse pier should be shortened about 300 feet, and the lighthouse removed to the west pier; and it is not improbable but that a small jetty would be required to be added to the inside of the outer end of the east pier as described in red. This work, however, is of minor importance and may be deferred until hereafter. The harbour of Scarborough, when completed as above recommended, would be one of the most efficient in this coast. The west pier might be extended further to the westward, and be constructed on the Ramsdale Scar. This, however, would make the harbour larger than necessary, and would moreover encroach too much upon the sands, and interfere materially with the comfort and salubrity and convenience of the town and its visitors, and would be attended with considerable additional expense, besides an increased annual cost in keeping it clear of sand; upon the whole, therefore, it is neither necessary or expedient, because if ever a harbour upon a larger scale than that above recommended should be required, it would be preferable to construct a proper breakwater at a sufficient distance in the bay, outside of the present harbour, in a depth of about 4 fathoms at low water of spring tides, provided with a double entrance, and capable of accommodating about 200 sail of the largest class of vessels, which could run for it and take shelter at all times of tide, and depart whenever circumstances might be favourable for them to pursue on their voyage; or if bound for the inner harbour, they could wait in safety until the tide had flown sufficiently to enable them to enter.

Whether as regards its projecting and commanding position in the German Ocean, (being one of the most prominent points along the coast, and only situated a short distance within the bold promontory of Flamborough Head, by which it is sheltered from the southerly gales,) the great depth of water near the shore with good holding ground; it being clear of sunken rocks and shoals, so that vessels can use every freedom in approaching and departing from it; also its proximity to good building materials, which renders the cost of constructing similar works comparatively moderate; all the above circumstances considered, (besides others which could readily be enlarged upon,) render the bay of Scarborough peculiarly well adapted for an asylum harbour of the above description, which is so much wanted, and would confer incalculable benefit upon the numerous shipping navigating these seas, many of which, for the want of a proper place of shelter, are frequently shipwrecked, accompanied with the lamentable loss of human life, and which upon every account it is so desirable to avoid; and it is confidently anticipated, that the expense of constructing such a port, would, in a few years, be amply compensated for, by the saving of human life and property above alluded to.

Having now, I trust, fully explained the mode and facility of carrying the above-mentioned improvements into effect, as well as the importance which would result from them to Scarborough as a port, both of refuge and of commerce,—it only remains for me, before closing this report, to point out the additional advantage which would arise from connecting it with York, and the immense manufacturing districts of the West Riding, and of Lancashire, by means of a railway, for which the intervening country is most favourable, as proved by the levels taken under my direction. Looking, therefore, at this subject in this extended point of view, such works would not only contribute to the prosperity of the whole surrounding neighbourhood, but would render Scarborough a most desirable outlet for

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exporting the manufactures to the Baltic and north and east of Europe, in the quickest and most economical manner possible, which now, from the long circuitous voyage to be encountered, as well as the too frequent detention by prevailing westerly winds, suffer a great deterioration, and, in many cases loss of their market altogether.

Again in like manner in returning, the improved harbour and communication, would facilitate the import of the raw materials into the manufacturing districts; and would moreover greatly increase the intercourse of passengers, both for the purpose of commerce as well as for deriving benefit from this celebrated watering place; and consequently there would be every reasonable prospect of deriving a proper return upon the capital employed, and rendering Scarborough one of the most flourishing places in the North of England.

I am, &c.,
JOHN RENNIE.

BRIDLINGTON.

No. 212.

Evidence taken on the 25th Oct., 1845.

No. 212.

PORT AND HARBOUR OF BRIDLINGTON.

Examining Commissioners—A. CHAPMAN, Esq., M.P., and Captain WASHINGTON, R.N. and F.R.S.

Present—A. STRICKLAND, Esq., Deputy Chairman; H. HARDING, Esq., Treasurer; J. BENNETT, Esq., Collector of Customs; Captain R. H. Elliot, R.N., Inspecting Commander; and A. WASHINGTON, Esq.

Mr. SIDNEY TAYLOR examined.—Has been Clerk to the Commissioners since 1837. The harbour is governed under 8 Acts of Parliament, beginning in 1697, and the last in 1837; for 150 years has enjoyed a passing toll on coals. There are 30 Commissioners, composed of landed gentry and clergymen, no shipowner, and only one sailor, and he has not qualified: only 15 out of the 30 have qualified. There are, besides, 6 lords, feoffees of Bridlington, who reside on the spot, and have qualified; 5 form a quorum. Vacancies are filled up by self-election; witness made the returns to the order of the House of Commons, in which it is said that there are no complaints of the state of the harbour; that is, no written complaint, as a vessel foundered in the harbour in 1842, and the agent for Lloyds had personally complained of the bad state of the harbour. The order of the House of Commons was read to the Board, but was not noticed in the minutes. Goodrick, C.E., reported on the harbour in 1816, Mr. J. Walker in 1838, and again in 1843. Has no copy of the last, yet under it the works are now carrying on and a contract has been entered into for 20,000*l*. The accounts are audited by the Commissioners themselves, and transmitted to Parliament. The Act authorizes to borrow 30,000*l*. upon the dues; have borrowed 15,000*l*., for which 5 and 4½ per cent. interest is paid. The annual income is about 3000*l*. a-year, of which about 2000*l*. is derived from a passing toll levied under 1 Vic. c. 110; salaries amount to 240*l*. a-year. The rates on lands and tenements, by Act of 33 Eliz., amounts to 265*l*. a-year. 5½ per cent. commission is paid on collecting the tolls. The Parliamentary expenses on the last bill were 4000*l*., the Bill renewing the power to levy a passing toll for 21 years having been violently opposed.

JOHN CAPPELMAN, harbour master.—Is a shipwright; worked on shore till the age of 18 years, then went to sea for 28 years. Acts under verbal directions of the Commissioners. Sometimes 20 or 30 vessels run into the harbour at once; in the year 1815 as many as 116 vessels entered the harbour in one month; in 1818, owing to 6*d*. a-ton being placed on vessels, they all abandoned the port. In the heavy easterly gales of the 31st Aug. 1833, saw 7 vessels ashore at once on each side of the pier; in coming in, vessels shoot over against the old south pier, as it is very difficult to clear it after rounding the north pier head; is of opinion that the north pier should be extended in a S.S.W. direction; there is a great accumulation of sand in the upper part of the harbour; west and W.S.W. winds fill the harbour with sand, and two feet depth of deposit comes from the land. Harbour was dredged by hand in 1816 and again in 1843, at which time 15,000 tons were removed at 6*d*. a-ton. There are cracks in the north pier, and it shakes when struck by heavy seas. A course of stone, 2½ feet above the ground, is left at the end of the pier, has been so for 15 months, has complained in vain of this neglect; the light at the end of the pier is a tide light, lighted only when there are 9 feet water at the entrance, the only light is a candle, and has known no other even with 200 vessels taking refuge in the bay in northerly winds; a permanent light at the pier end might be the means of saving many a life; many a fishing boat and coasting vessel might run in and be saved.

Mr. HOWIE, resident engineer under Messrs. Walker and Burges for the harbour works now going on.—The foundations of the new south pier are laid for 1100 feet; the whole length will be 1530 feet, and the width 20 feet; the outer kant, 25 feet, to be finished with a circular head. Since the work was begun, additional square jetties or buttresses have been placed inside for extra strength; the parapet wall will be 5 feet high; this pier is founded upon clay; it is to be faced with Whitby stone filled in with chalk rubble; it dries throughout at low-water springs. The sand scours away in parts on the south side of the pier in S.W. and W. winds, and the least so in northerly winds. The old pier of oak piles, and filled in with stone rubble, has stood well. Area of old harbour 5½ acres, of the new 12 acres; it is intended to excavate to a depth of 12 feet at the upper end of the new portion of the harbour at high water, and to 18 feet towards the pier end. Half the old pier will be left to form a quay. The contractor for the works is the same as built Granton Pier and part of Liverpool Docks.

Mr. HARDING, treasurer, has been 30 years a resident. Is of opinion that Bridlington Bay is the finest position for a harbour of refuge along the east coast of England, and is exactly in the spot where such shelter would be most useful for the vast traffic that passes along the coast; in the year 1811 witness counted 450 vessels in the bay, and 1000 sailed past Flamborough Head in one day. In a north wind no light vessel can get into the Humber; has seen 17 vessels ashore at once on the Lincolnshire coast. If the vessels' ground tackling is good, they will ride a gale out in the bay, as the holding ground is good and the pull up hill in on shore winds. The Smithick Shoal, which extends across the mouth of the bay with only 13 feet on it at low water, affords great shelter even in its present state, but if improved by a breakwater being placed upon it, the bay would afford the finest shelter and the easiest of access on the east cost of England. It was a conviction of the value of the bay that induced Parliament to renew the passing toll in 1837 for 21 years, in order to make an inner harbour from which supplies to wind-bound ships could be sent off with certainty—and this Bridlington, when its new south pier is finished, will be in a condition to do.

JOHN WALLIS, a pilot and fisherman, 17 years at sea.—The surge of the sea in the harbour is very great; the anchorage in the bay is good, no foul ground; 300 vessels left this week; in northerly gales vessels can anchor in the bay in shelter when they cannot take the Humber. Vessels from the Baltic bound to London and Hull, always make Flamborough Head in the fall of the year, and often anchor in the bay. Berwick and Hull traders also frequently anchor here in N.N.E. winds. Vessels for Filey Bay also run for shelter here. Was on board H.M S. "Driver" when she was on Steel Point under Flamborough Head; aiding in getting her off. Has known 40 vessels ashore between Sewerby and the Head; a stranger might run at any time into the bay: great want of accommodation for fishermen; yet it is one of the nearest points to the fishing grounds of Dimlington, &c.; at least 200 sail of river and Torbay boats fish on the Dogger Bank, and this is one of the nearest places to land their cargoes, a boat-slip or beaching place is much wanted in the harbour; if the railroad were brought here, there can be no doubt but that it would be a great resort for fishing boats; fishing vessels therefore should have every accommodation, instead of none. Has seen every vessel in the harbour adrift in an easterly gale, owing to the range of swell; all their ropes broke, nothing would hold them; the fishing vessels then had no chance, and no one to look after them; has known the harbour dry for 65 yards without the pier head at low-water springs; vessels ballast from the harbour; stones are taken from the beach, which ought to be put a stop to.

Mr FROST related the transactions connected with the endeavour to obtain a new Bill in 1836, in which he contended, the interests of the rate-payers were not consulted; he said that when the inhabitants remonstrated against the unequal charges which were proposed, (land being left almost free of toll,) the deputations were told by one of the Harbour Commissioners that if they were not satisfied they might go to the House of Commons, and their opposition their would cost them 1000*l.* Great opposition was encountered in getting the Bill; a public meeting was held, and the inhabitants consented to tax themselves on the promise of the Commissioners, that men connected with shipping and trade belonging to the place should form a part of the new Board; that the harbour should be begun and carried out immediately, and that a proper engineer should be employed, in order to prevent the waste of money that had occurred in building the north pier; and that the tax upon tonnage should cease in 21 years; all these promises, he contended, had been broken; that the harbour works had been unnecessarily delayed, and the plan, if carried out, was faulty; no one connected with shipping formed a part of the board; and the tax, instead of being for 21 years, was laid on for ever. Witness had made a written complaint of a vessel having been wrecked in the harbour; he had also loudly complained of the injustice committed upon an Oldenburg ship, which, under the Reciprocity Act, was free of double charges, yet the master of her was taken before the magistrate, and a distress warrant issued against the ship, her sails taken away, &c.

Mr. A. STRICKLAND, the Deputy Chairman, explained, that the difficulty of obtaining the Bill was so great, and the opposition to it so violent, that it was absolutely necessary that some local tax should be laid on to meet the tax in the shape of a passing toll, to be paid by the vessels from Newcastle, &c., and he still considered this was just; as for the public meeting of the inhabitants of the town, he had never heard of it.

Mr. BENNETT, Collector of Customs, stated, that there was a great want of quayage in the harbour; that there was no legal quay, but that, for the convenience of trade, he suffered vessels to land their cargo.

BENJAMIN SAWDON and JOHN LYONS, pilots and fishermen, confirm all that has been stated by Wallis respecting the harbour and bay; they consider Bridlington Bay is a harbour of refuge, and one of great value to the vast number of ships that pass along the coast, and particularly to light colliers; have seen 350 in the bay at one time; are of opinion that a buoy off Flamborough Head Ledge would be a good thing, but still more is a buoy wanting off the end of Filey Brig; many a vessel with a scant wind hugs the land, and gets ashore on these rocks; and in a fog, worse than all. A former collector of customs, Mr. Milner, proposed a warning bell to be worked by water, which might be placed both at Flamborough Head and at Filey Brig, or off any other projecting ledge of rocks which is likely to bring up a ship. Fishermen are very badly off in Bridlington Harbour; they have no place to go to, and the beach to the southward of the old south pier is now so covered with stones for the new work, that it is dangerous for a boat to land there.

Mr. THOMAS BRAMBLES, Lloyd's agent for 10 years; is a native of Bridlington; has been 50 years at sea; as many as five vessels get ashore annually between the Spurn and Flamborough Head; has had 20 vessels here under serious repair, and the place can supply everything a ship can want, from an anchor to a mainmast; never had occasion to send a vessel away for want of ability to repair her; in 1841 put a new keel into the *Sceptre*; has known as many as 90 vessels in the harbour at one time; 30 loaded vessels put in every year in distress, and had they not had this harbour to run for, they must have gone on the beach. Objects to the direction of the new north pier, would have had it built straight and outside the old timber pier, instead of coming within it, and thus have given more room in the harbour; this would also have afforded quays and wharfs, which are so much wanting; the range of swell along the pier is now so great that no ropes will hold the vessels; while the old timber frame-work of the new pier was standing, it broke up the sea as it came into the harbour; there is no provision made for a dry-dock; none for the fishermen, and yet no place is better situated with respect to the fishing grounds; turbot is now sold at 2*s.* 6*d.* in Bridlington, and when the railways approach, as they will shortly, connecting this port with York and with Hull, the demand will be great, and will not be able to be supplied, owing to the want of accommodation for fishing boats. The old timber jetty, 70 years old, still stands, unharmed by worm; is of opinion that nothing but an island pier will quiet the swell in the harbour, for this is the great evil, and fears that it will still be felt when the area is increased; no hawsers, and not even chains, will hold the vessels, so great is the range of the swell towards high water at spring tides. Bridlington Bay is good holding ground, and the Smithick sand affords some shelter, yet 50 anchors and cables are lost in the bay every year, partly owing to bad chains and bad windlasses; a breakwater on the Smithick is the great want; has long felt this, and has not ceased to press it on every occasion for the last 20 years; to say nothing of the lives that might have been saved, the property lost during the last half century for want of such shelter would have sufficed to build a breakwater; has reason to think that the Smithick is composed of chalk, it takes the direction of the chalk along the coast, and another proof is that lobsters are found on it; thus the foundation would be secure, and for material, chalk rock and stone might be had in abundance at many places along the coast to the northward. In heavy northerly gales, has known vessels run back from Berwick to obtain the shelter of Flamborough Head; if the wind is to the northward of north-east round to north-west, vessels cannot get into the Humber, especially light vessels. A vessel from off the Tees was driven back only last week. Has seen, in the year 1811, as many as 300 vessels detained for six weeks in the bay by northerly gales; and had it not been for the supplies of water, beef and bread, that they received from Bridlington, the greater part of the crews must have starved, as colliers only carry provisions for a certain length of voyage; all his experience goes to show that a harbour of refuge in Bridlington Bay would be the greatest boon that could be offered to the vast number of shipping that trade along the east coast of England.

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No. 212.

Evidence taken on the 25th Oct., 1845.

No. 213.

Report of SIMON GOODRICK, Esq., C.E., *on the proposed Enlargement of Bridlington Harbour.*

No. 213.

Goodrick, on enlarging the Harbour.

Mile End Lodge, near Portsmouth,
29th September, 1814.

SIR,

HAVING been called upon by the Commissioners of Bridlington piers for my opinion and assistance, relative to the piers and harbour of Bridlington, with a view to the reparation and preservation of them; and to further improvements which it might be expedient for them to make, and to provide for, on a revival of the Act of Parliament under which the Commissioners are appointed, and having surveyed the piers and harbour between the 22nd November and 9th December last, including the occurrence of two spring tides, and collected various information on the spot and in the neighbourhood, I beg you will lay the result of my observations on this subject before the Commissioners, together with the accompanying plan No. 1, design No. 2, and specification explanatory of this subject.

Bridlington Bay, which is situate nearly in the middle of the eastern coast of the kingdom, is formed by the sudden projection of Flamborough Head on the north, and the less sudden projection of the coast towards Spurn Point on the south, and is thus protected by the land from winds and storms, from the north-east round by the north to the south-south-west, above half the compass. The Smithwick Sand, about four miles in length, also forms a natural breakwater on the side of the bay which appears open, and abates much of the violence of the storms upon it from the south to the east. The bay has a good inlet and outlet at the north-east and the south, between the ends of the Smithwick Sand and the land; and there is a good depth of water, safe anchorage, and ample space within it for large fleets; under these favourable circumstances, with the advantage of the light established on Flamborough Head, Bridlington Bay becomes a place of shelter and of great resort for ships northward or southward bound, meeting with contrary winds, so that it happens sometimes that 200 or 300 sail are lying in it waiting for a wind. . . . . . .

Bridlington Harbour is advantageously situated at the bottom of this bay, in which harbour the numerous coasting ships resorting to the bay, either from stress of weather or contrary winds, should find a further place of refuge from storms from the eastward to the southward, to which the bay is exposed, and from which it might happen that the ships could not get out so as to clear Flamborough Head to the northward, nor yet work to the southward so as to get into the Humber. In this case they must either attempt to ride out the gale, or cut at a proper time of tide and run for the harbour, or drive ashore. The circumstances in this case, are also much in favour of the harbour as there are no rocks or sands to make the approach to it dangerous; and the coast on each side of the harbour is a flat beach of sand upon clay, upon which the ships may run ashore without certain destruction of life and property, in case they cannot make the entrance of the harbour. Vessels within the harbour lie safely protected by the piers; and as the approach to and entrance into it is very favourable with such winds as make it desirable for ships to seek refuge there in preference to lying in the bay, so likewise the outlet from it is equally favourable with such winds as may enable the ships to proceed on their voyage. From these circumstances it appears that the maintenance and improvement of Bridlington Harbour must be an object of great importance and utility to the maritime interests of the kingdom, for shipping employed in the eastern coast between the northern and southern ports; and also for the shipping to and from the North Sea to the Baltic.

The harbour is formed artificially by two piers, and is what is termed a dry harbour, as it runs dry or nearly so at low water, and the vessels within it then lie aground. It is however very favourably circumstanced in this respect, the ground not being rocky to injure the bottoms of the vessels, neither is it a shifting sand, which, by washing away unequally from under the bottoms of the vessels, strains and injures them in that way; but it is a compact clay with a little mud over it, upon which the vessels may ground with the greatest safety. The present piers, as shown by the accompanying plan No. 1, enclose an area, taken at the surface of high water from the entrance of the harbour up to the bridge leading over the rivulet into the town, of about five acres and a half. This space being long and narrow, is well adapted for being scoured out by the backwater of the before-mentioned rivulet which runs through it, and which, for several months in the year, supplies a rapid stream. It however does not appear that there is any particular tendency in the harbour to silt up, so that the backwater of the rivulet may be directed not only to keep it open to its present depth, but also to a greater depth in a great part of its present extent.

Having premised thus much on the importance and favourable circumstances of this harbour, I proceed with the object of my survey, to point out the defective state of its works, and to propose the remedies, limiting my views to the means which probably might, and which it is highly expedient for the maritime interests of the kingdom, should be obtained on the renewal of the Act of Parliament for the maintenance of it.

One great defect consists of the decayed and dilapidated state of the piers, so that the danger of the harbour being rendered totally useless by the failure of them in some heavy storm, particularly of the north pier, gradually approaches. This defect arises from the piers being originally formed of a framing of piles and timber planks on the inside and filled with loose ballast and chalk stones. This was, no doubt, the easiest and cheapest method to form them at that time; but it becomes exceedingly difficult to repair such a structure, and extremely expensive since the increased price of oak timber, and none but the very best and of the largest dimensions is fit for these large piles and transverse beams, which is scarcely procurable now at any price. But besides the quick decay to which the timber is liable, exposed like this to the alternate action of the sun, air, and water, its destruction is greatly accelerated by the existence of a species of small worm at this spot, myriads of which penetrate and macerate the surface of wood exposed between the ground and high-water mark, so that the largest piles and thickest planks are eaten through by them long before they would otherwise have been destroyed by natural decay.

In consequence of this evil, it appears that the additional length of 60 feet, which was last made to the north pier, and which was begun in 1792, was constructed entirely of stone; it appearing by the papers I have seen, to have been intended a solid piece of stone work set in mortar: and subsequently to this, between the years 1802 and 1808, with a view to strengthen the other part of the north pier on the sea side, and to protect it from the worm, the wood-work has been cased for a length of 240 feet with stone-work, intended to be solid 7 feet in thickness, connected with the stone extension at the pier head, which was made 7 feet wider than the old wooden pier on that side, to admit of the junction. It also appears that in the year 1799, before the work of the stone pier head was fully completed, that from the washing away of its foundations, it was in imminent danger of being destroyed. It was therefore supported with an apron of stone-work at its foot about 13 feet in width, and 2 feet 6 inches in depth, consisting of large stones with piles in front of them; this apron is also continued about 6 or 7 feet in width along the foot of the casing.

I have been thus particular in the description of these works, because therein exists great defects, and the greatest danger of failure. These defects are the bulging and sliding outwards of the foot of the stone pier on the sea side, and of the casing, notwithstanding the apron which has been laid to support and protect it; this causes cracks and derangement in the outside courses of stone above, though consisting of large blocks, and disjunction within. The more the foot of the wall slides out, the more the tendency to slide out encreases in consequence of the encreased batter or inclination of the outside wall; I attribute this defect in the stone extension partly to the great batter originally given to the outside of the work, partly to the bad laying of the foundation stones, and their not being properly engrafted into the clay, and partly to the mortar that had been used in the work, either not having been filled flush into the joints or that being of an improper kind for water works, it has been washed away. The violent beating and rising up of the waves against the pier forces the water into it at every open joint and crevice of the outside work—meeting with larger cavities amongst the rubble work of the inside, a considerable quantity and head of water is accumulated within the pier, which water on the retiring of the wave gushes out again through the openings, particularly at the foundation, with great force. The clay foundation, though otherwise solid enough to bear any weight of pier, is thus gradually washed away and sapped, and the stone-work resting upon it gradually settles and cracks to pieces, and losing its proper bond and connexion with the inside work which becomes at the same time a heap of loose stones, the outside wall is thereby pressed outwards and bulged.

The same reasoning applies to the same defects which show themselves in the stone casing, and the evil must be greatly encreased as the wood-work decays, against which the casing is applied and leans with so great a batter. It is also probable as the stone-work does not and cannot fit entirely close to the wood-work at all parts, that it is little or no protection against the destruction of the worm.

The remaining outside part of the north pier from the stone casing to the stone bulwark is not in so dangerous a state as it is not in such deep water, and is protected by the breakwater which also causes the sand beach to accumulate against the foot of it. Moreover as the wood work decays, it is here practicable to patch and repair it, though with great expense and difficulty.

The stone bulwark in the angle at the north end of the north pier appears a very good piece of dry masonry in large blocks; and here the advantage of not giving so great batter is apparent towards the stability of the work; for though the waves strike in this angle with great force, the foundation remains unsapped and the stones undisturbed.

The inside of the north pier from the stone extension up to the crane wharf being of wood, is subject to rapid decay, though not being exposed to the violence of the sea, is not so liable to be sapped and disturbed. The whole of this north pier, excepting the stone pier head and the stone casing, is covered with a wooden deck which is a further subject of constant repair and expense.

The whole of the present south pier is formed in the manner before mentioned, of piles and plank filled in with loose ballast and chalk stones, but has no deck, neither is it of such large dimensions in width and height as the north pier. It appears from an old plan that 753 feet in length of this pier from its head or last end, has been re-built since the year 1719, principally upon new foundations, and subsequently to this 277 feet more; and as I found it about 1108 feet in length, I apprehend from appearances the last 78 feet have been recently added. The breakwater of piles near the west end of the pier, to stop the encroachment of the sea upon the shore, was added in 1810. The line of the old south pier ran considerably within this, so that, though the barhour was then much smaller than at present, it appears in the various Acts of Parliament for its support, to have been considered of great public utility. The two first portions above mentioned of this south pier, that is, nearly the whole of it, is in a very decayed state; being, however, protected by the north pier from the most raging seas, it is not in such imminent danger of sudden ruin, though very expensive and difficult to be kept in a state of repair.

The piers being the objects of vital importance to the existence of the harbour, till sufficient means can be found for their support, the other wharfs and boundaries of the harbour can claim but little attention, otherwise the crane wharf appears the first to require notice, since being formed of wood it is much decayed.

Another very material defect of this harbour is, the shallowness of it over a great part of its extent. This does not appear to have arisen from any considerable quantity of silt or mud brought into it, but from the natural ground never having been removed from the bottom of it. In the race of the beck or rivulet that runs through it, the ground is washed away to a greater depth than in other parts. The depth of water at the entrance opposite the end of the south pier appears at a spring tide to be now about 17 feet, this depth continues a little way in along-side the north pier, and dies away to 16 and 15 feet. There is also with such a tide, without noticing the extra depth of the beck race, from 14 to 12 feet depth of water across the harbour, at about one-fourth the way up, which gradually diminishes to 7 feet at about half the way up, and it goes on diminishing in depth to the upper end. The perpendicular flow of the spring tides being here from 17 to 18 feet, the capacity of the present harbour might be encreased by deepening for the reception of three times the number or more of large vessels than it can at present receive. It might be progressively further encreased by widening it at the upper end, and removing the clay cliff which projects into it. There appears at present no tendency in the harbour to choak and silt up with sand or mud; and no greater degree of silting up is to be apprehended with an encreased depth than what may be easily removed by the assistance of the backwater of the rivulet; besides that, a little mud or silt upon the clay bottom after the harbour is deepened may be deemed an advantage for the grounding of the vessels.

The small funds by which this harbour has been maintained appear, under its present circumstances,

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very inadequate to its support or improvement, especially as the stone work to the north pier which has been so lately erected at a great expense, is in so dangerous a state, and although the whole at the present income may be now expended in repairing and sustaining the present piers with the greatest judgment, their decay must still be gaining ground, and the harbour go to ruin; I shall so propose the plan of proceeding that benefits may result in the second year equal to or surpassing the additional tax; and could the income be increased to about 5000*l.* a-year, the works and improvements which I have to submit might be undertaken with spirit, and the harbour be rendered permanently useful and important, in a proportion greatly exceeding this addition. I must leave it to the Commissioners, or others possessing better data on this subject than myself, to form a proper scheme of duties that ought to be proposed for this purpose, and to estimate the amount of them; but would suggest that the farthing per chaldron duty on coals, originally granted in the year 1697, be increased; that a new duty per ton be laid upon all coasting vessels and vessels that pay to Flamborough Light of 300 tons and under; that some additional duties be laid upon the vessels using the harbour, which should increase at the rate for the time they laid there, and that the present pier rates on the manor of Bridlington be also increased.

From the whole of the foregoing considerations I therefore submit the accompanying plan No. I, and design No. 2, with the specification and particulars for the reparation and enlargement of Bridlington Harbour. These works are more briefly described as follows, with the amount of the estimate for each added.

1. To repair and sustain the stone-work of the north pier head and of the casing, and to support the foot of it by piles, and by throwing down the clay dug out of the harbour in deepening it. 600*l.* per annum.

2. to keep in repair the wood-work of the present piers just as far as may be necessary for their immediate preservation till the new piers are completed. 600*l.* per annum, till south pier be erected.

3. To deepen the present harbour by washing out the soft soil and carrying out the clay till there shall be 17 feet water at the lower end of it, and 15 feet water at the upper end, upon an average 16 feet depth of water, over the whole extent of it at a spring tide, and to throw the clay dug out behind the present north pier, to support the foot of it as before mentioned. Estimate, 3150*l.*

4. To take down the east end of the present south pier so as to widen the entrance into the harbour with a view to building a new north pier within the line of the present north pier, without preventing the use of the harbour, and to make good the new end of the south pier and refix the jetty. 700*l.*

5. To erect a new north pier of stone in a solid substantial manner within the line of the present north pier about 466 feet long, beginning at the pier head and carrying it on progressively till it joins the Crane wharf and the stone bulwark at the north end of the old north pier. The old north pier may then be taken down and its materials made use of. A proper capstan leading sheaves and post to be fixed upon the pier, also a flag-staff with a flag to indicate the depth of water by day, upon which staff also a light may be hoisted for the same purpose by night; Flamborough Light serving as a sufficient guide to the bay till near the harbour. Estimate, 22,790*l.*

6. To erect a new south pier of stone in a solid and substantial manner without the line of the present south pier about 1236 feet long, beginning at the pier head and carrying it on progressively; a capstan and posts to be fixed upon the pier: when the new south pier is completed, the old south pier may be taken down or part of the old south pier may be taken down after part of the new south pier is completed, allowing the new pier to overlap the old one considerably. The new part of the harbour to be maintained to the full depth of the old part. Estimate, 48,070*l.*

The value of the materials of the old piers is allowed to cover the expenses of taking down and other contingencies.

In the foregoing estimate I have included the duty which I understood was 32 per cent. on the value at the place of delivery of the stone for the facing of the piers, on account of its having to be shipped and brought coastwise, which otherwise would not be chargeable with any duty, and which is thus a duty on the cost of carriage and freight as well as on the original cost of the stone.

A remission of this duty, which it seems desirable to obtain in favour of this particular case, would reduce the estimate for the north pier by the sum of 2170*l.* and for the south, by the sum of 3859*l.*, in all, 6029*l.*

These works may be undertaken and proceed in the order in which they are described, with the before-mentioned revenue of 5000*l.* per annum; but if a revenue to this extent cannot be obtained, I still see no better way than to proceed in this order, and to accomplish as much as can be done with a smaller revenue, as the benefit will still be great in proportion to the works completed.

By the execution of the whole of these works, the capacity of the harbour by deepening and enlargement will be encreased at least six times more than the present capacity for the larger vessels, and there will be abundant room for the smaller ones. The piers will be of that substantial kind as not to require repair, and if the funds be sufficient, any further improvement and extension may take place in the upper part of the harbour, and a basin formed when required for shipping to lie afloat in; also to serve as a reservoir for a powerful back-water to scour out and deepen the harbour to a greater extent. A dry dock may also be formed for the repair of shipping.

I beg, Sir, to express my regret to the Commissioners that I have not been able to complete this Report so soon as they may have desired, and I had reason to expect. This has been owing to my re-appointment in the service of Government as engineer and mechanist, after I had undertaken this business. I must now beg to resign it to any other person the Commissioners may be pleased to select, but shall be very happy at any time to communicate and explain everything in my power to him or to them on the subjects I have submitted.

I am, &c.,
SIMON GOODRICK.

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Specification, &c., agreeably to Plan No. 1 *and Design No.* 2.

1. To sustain the stone-work of the north pier head and the stone casing of the north pier in the manner that it is at present done, by well fastening in the outside stones that get loose with oak wedges, using where it can be done, folding wedges, that the tails of the stones may be supported as well as the fronts. A composition likewise of half Roman cement of good quality and half sand mixed up with sea water, may be filled flush into the joints at the parts that fail, so far back if possible, as the bed of the outside stones extend, but not so as to waste it in the great interior cavaties; also to drive strong piles close to the front of the apron, and at the foot of the pier or casing where it can be done, to stop the spreading out of the foot, and to wedge the apron stones that may be loose between these piles and the foot of the wall. When the weakest parts of the footing shall be thus sustained by additional piles, to throw down upon the apron the clay dug out in deepening the harbour, taking care that the first of it be well rammed into all the open joints of the stone-work of the apron and of the footing of the wall. To continue afterwards to throw down this clay upon the apron, and to heap it up against the foot of the pier to any extent that may not be found inconvenient, in order to produce a counter pressure against the foot of the pier and to prevent in a great degree the washing in and out of the water which does so much mischief. The waves may wash away this clay, but during the deepening of the harbour it may be constantly removed without additional expense, as there seems no better place to dispose of the soil.

2. To keep in repair the wood-work of both piers just as far as may be necessary for their immediate preservation till they can be dispensed with by the erection of the new stone piers.

3. To deepen the present harbour so that there shall be across the whole width of it 17 feet water at the lower end, and 15 feet at the upper end near the projecting cliff, making an average of 16 feet on the whole extent of it at a spring tide; taking care, however, not to undermine the foot of any of the present wharfs or piers, but to allow the ground to fall from the foot of them one perpendicular foot in three horizontal feet. This will require the removal of about 31,500 cubic yards principally of clay; the mud on the upper surface may be thrown into the beck, so as to be thereby washed out of the harbour's mouth; the clay to be dug up at the time of low water and thrown into boats or barges provided for the purpose, which in fair weather and at a proper time of tide may be towed behind the north pier, and the clay there deposited for the reasons before mentioned. These barges might have an open space with inclined sides like a trough for the reception of the clay, with doors at the narrow bottom of the trough to let it fall out. The barges must have sufficient compartments at the ends and sides of the space for the reception of the clay to render them buoyant when loaded; and if there be danger of swamping, these buoyant compartments may be decked. Means may be also adopted for loosening and digging up the clay and mud with spoons, after the manner of raising ballast and loading the barges whilst the water is in the harbour. Part of it also from the upper end might be taken out in carts. I can only suggest some means here as much will depend upon local circumstances and conveniencies, and many expedients would occur on the spot to the undertaker of this work. The back-water of the rivulet should also be made as much use of as possible, to wash out the clay after it is loosened and thrown in the way of its current.

4. To take down the east end of the present south pier as shown on the plan No. 1, to root up the foundation of it deep enough for the new channel into the harbour, and to make good the new end of the pier; also, to take down the jetty, thus cut off and to refix it in the new situation. In the execution of this work, a breach may be first made through the pier, at the place of the new end, and the new end made good before the present end of the pier is taken down, which may then be done. This work is for the purpose of widening the entrance into the harbour, to admit of a new north pier to be built within the line of the present north pier, without preventing the use of the harbour, as follows:—

5. To erect a new north pier of stone, about 466 feet long, within the line of the present north pier, agreeably to the plan No. 1, and the particulars of the design No. 2.; to begin with the pier head in the first instance, and carry up the work to the whole height of the pier in as short a length as is practicable, as shown by the elevation. The head of this pier to stand a little in advance of the present pier head. This part of the work will be the most difficult, on account of its being the most exposed to the violence of the sea, and as the space between the two piers arising from their batter would be particularly subject to the attacks of the waves, which would rise up and break in between the piers with great violence, it is proposed as the new pier head is carried up, to carry up at the same time a temporary bulwark of large stones between the two piers, just at the hollow part of the new pier head, as shown in red on plan No. 1. The stones forming this bulwark to be such as will afterwards be used in the facing of the piers, to be laid in several lengths at the base longitudinally between the new and old pier, and resting upon their battering sides, and to finish at top with about two lengths of four foot stones, forming a bridge eight feet wide from one pier head to the other. The new pier head and bulwark being completed, the remainder of the new pier may be much easier carried on under the cover of them and of the present north pier, which should not be disturbed till the west side of the new pier has been connected to the crane wharf, then part of the old pier which is shown by plan No. 1 as intersected by the east side of the new pier may be taken down and the new pier completely connected and made fair with the present stone bulwark at the north end of the old pier. It is proposed to keep the footing of the east side of the new pier as far as the intersection just within the footing and piles of the west end of the old pier, so as not to be prevented thereby from driving the new plank piles at the footing of the new pier. A row of plank piles, elm, beach, or larch, longitudinally tongued and groved four inches thick and five or six feet long, to be driven firmly into the clay at the foot of the pier. A cross row of such piles may be driven as occasion requires to complete the enclosure of a small length of foundation. It is intended that at the pier head and in the deep parts of the pier, the top of these piles should be level with low-water mark upon a good spring-tide ebb, when the pier is finished as shown by design No. 2; but in the execution of the work, the piles may be left a foot or 18 inches higher than this, in order to serve as a low dam to give more time at low water for laying the foundation courses. The heads of these piles may be afterwards cut off to the proper depth. The best way of forming these piles, is to cut a grove in one about two inches square, and to nail a square tongue piece upon the other of dry wood to fit the grove. The foundation for nearly the whole of the north pier and for above half of the south pier is thus intended to be laid two feet below the water mark at the lowest spring-tide ebbs. The sand and loose soil is to be cleared away from the space enclosed by the piles as much as possible, and then a stratum of single stones without sand to be well rammed into the bottom to consolidate it; this may be done through some

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depth of water with an iron rammer attached to a long wooden handle lifted by four men; upon the bottom thus rammed is to be bedded in composition hereafter described, the first course of outside stones as shown by the design No. 2, and also the rubble stone in the interior part, taking particular care to fill the whole up flush and solid with the composition. The space enclosed in thus laying the foundation course may be small, to be the quicker cleared out at the time of low water, and so much foundation formed. The transverse row piles to be then drawn and another small space enclosed further back for another small portion of foundation; it will be easier to form the second course and progressively easier for the others, but too much pains cannot be taken in driving the piles, well ramming the foundation and laying the first courses. Bramley Fall stones to be used for the facing and pavement, and in general, in preference to the Whitby stone, excepting the using up of the Whitby stone from the old north pier, as soon as it can be admitted to be taken down, for the upper parts on the harbour side of the new piers. The parapet to be of long Whitby stones if they can be obtained cheaper than the Bramley Fall stones. The facing stones to be laid square to the facing of the wall as shown by design No. 2, and to be of the general dimensions therein shown by the scale, and marked by figures; a variation from the design of the thickness of the courses may be admitted, putting the thinest courses at top except the cordon course on the outside, and the capping course on the inside of the pier, which should be at least of the thickness shown. The rubble stone for filling in to be the best hard chalk stones, brought from Flamborough Head cliffs, such as will rise up in broad flat pieces. The composition to be used in the joints of the facing stones. Pavement and parapet to be one part by measure of Roman cement of good quality, and one part course sea sand, clear of pebbles, and clean from clay, mixed up with sea water. The same composition to be used in the foundation courses of filling in stones for three feet up; and the composition for the remaining filling in to be two parts by measure of sea sand, and one part of Roman cement of good quality; or otherwise to be mortar made of Doncaster lime, to be burnt on the spot, say four parts by measure of Doncaster lime, three parts sea sand, and one part minion, mixed with sea water.

Minion is the siftings of the scales and matter resulting from the roasting of iron ore, and is procurable from any of the large iron-works in Yorkshire. I was informed, that it could be put on board vessels of 60 tons on the River Don at Rotherham for about two shillings a-ton. The Doncaster limestone is procurable from the quarries a few miles lower down on the same river, and there also coals might be shipped for burning the lime at about 6*s*. or 6*s*. 6*d*. per ton.

To fix a good capstan at north pier head, with leading sheaves to direct the ropes. A proper well for the spindle of this capstan to be formed in carrying up the stone work; also to fix some posts upon the north pier for fastening of ropes, and a ladder in a convenient place on the harbour side. To fix likewise upon the pier head a mast for hoisting a flag by day, and a large lantern by night, to indicate a certain depth of water at the entrance of the harbour. The light at Flamborough Head will be a sufficient guide to the bay, consequently a much smaller light will do for the harbour.

6. To erect a new south pier of stone, about 1236 feet long, without the line of the present south pier, agreeably to plan No. 1 and design No. 2, with the same kind of materials, and after the same manner as before described for the new north pier. To fix a capstan and proper posts upon it for fastening ropes, leaving holes for the posts in bringing up the stone work. The foundation of the head of this pier to be laid as before described for the new north pier, two feet under the lowest spring-tide ebbs, and continued at that depth about one half the length of the pier, it may diminish in depth in the other half, though not more than three feet at the upper end. To remove the old south pier and root up its foundations to the general depth of the harbour, taking care to draw all the stumps of the piles. Also to fix a new row of dolphins, which may be formed principally of rubble stonework, set in Roman cement and sand rather than of timber.

29th September, 1814. SIMON GOODRICK.

No. 214.

No. 214.

Walker, on a proposed new South Pier at Bridlington.

JAMES WALKER, Esq., C.E., *on a proposed new South Pier at Bridlington.*

SIR, 23, *Great George Street, Westminster*, *26th Sept.* 1843.

The order of the Commissioners of Bridlington piers and harbour, made on the 6th of June last, requests my attention to the subject of a new south pier, of which I am desired to prepare a plan and estimate, and to visit Bridlington, if I should think it requisite, for that purpose.

In compliance with the above I visited Bridlington, in company with my assistant, Mr. Deane, towards the latter end of July, when I again surveyed the harbour and the places near to it; I also attended a meeting of the Commissioners, after which I took the opinions of Mr. Lamprey, your harbour master, Mr. Grey, your engineer, and of such pilots and shipmasters as were brought before me.

As the plan and estimate of the proposed work could not be made without a correct survey of the place, and observations upon the tides, &c., I left Mr. Deane behind me for this purpose; he completed his work by the 14th of August, and has prepared a plan, a copy of which accompanies this Report. I have since received from you a copy of the order of the 5th instant, requesting me to attend the general meeting of the Commissioners, on the 26th September, and to lay the plans and a specification before them.

I beg now to submit a design for a new south pier.

The direction of the proposed new pier is nearly parallel to the old south pier, at 250 feet distance, until within 100 yards of its eastern termination, where there is a "kant" to bring the end of the pier, or mouth of the harbour, within the north pier; this will shelter ships in entering from the direct action of winds north of south-west, at the same time the greater length or overlap of the north pier will not be such as to interfere injuriously with the current of the ebb-tide. The form I have given to the head is intended further to prevent this by shooting the current round the end of the north pier, so as not to form a strong eddy at the entrance, which would cause a shoal or "canch" there, as is the case at present; again, ships entering with a north or head wind will have sufficient way upon them to carry them past the south pier into the harbour, and will also be able to work in, when the wind is directly out of the harbour. All these are points of great consequence, which it is difficult entirely to reconcile; my object has been to do so as nearly as I could.

The width is another important point as respects the entrance: the present width between the north end of the jetty and the north pier (the present entrance) is only 60 feet; this is allowed to be, and is,

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too narrow for large steamers and ships of heavy tonnage entering in a disabled state, or in a gale of wind; yet with this width the harbour is very much disturbed in south or north-east winds; the seas roll along the smooth face of the north pier to the north side, whence they are reflected across and along the harbour with great violence: the width ought not therefore to be greater than is just necessary to allow of ships entering, although a still greater width would be useful for ships to work in. I have drawn it 30 yards, which is an addition of 50 per cent. to the present width of the narrowest part; but as the present area of five acres will be increased to more than twelve acres, giving that additional area for a wave to expand itself over, and as in measuring the present width, reference should be had to the width of the south end of the jetty, or mouth of the funnel-shaped entrance, which is about 29 yards, I have no doubt of the enlarged harbour with its new entrance being much quieter and safer than it is at present. A jetty of piles filled with very rough stones, if made in the "kant" at the north pier opposite the present south pier (shown by red lines upon the plan), would effectually break the run of the seas along the face of the north pier, and be also useful as a landing. The cost will not be great.

A detailed specification is prepared to be laid before the Commissioners, of which the following are the leading features:—

Both sides of the new pier are to be faced with Whitby stone, laid in mortar and pointed with cement, and the interior filled in with squared blocks of hard chalk laid in courses. The pier is to be 20 feet wide at the floor level, which is four feet above high water of spring-tides, of which 16 feet in width will form a way or passage, and the remaining four feet will be raised six feet higher, or to a height of 10 feet above high water, as a parapet. The length of the pier is 1000 feet, commencing from the shore at about 500 feet to the west of the town, to which it is connected, in the same line with the pier, by a causeway 30 feet in width, having a sea-wall similar to the outer wall of the pier, and backed with the excavated material, formed at the side next the harbour to a slope of three to one pitched with square stone laid upon concrete. The entrance of the harbour is to be excavated to a depth of 18 feet 6 inches below the high water of spring-tides, decreasing to 14 feet 6 inches at the west end of Mr. Hall's timber-yard.

My estimate for the work is 33,107*l*.

I have not calculated the deepening to extend farther than the west end of Mr. Hall's timber-yard, in case it should be thought desirable at some future period to terminate the harbour there by a wall and quay, or road across the harbour, and to convert the part to the westward into yards and other purposes connected with the harbour, or into building or repairing-slips. A section for a cross wall is given, but is not recommended to be built at present.

I take the liberty to add a few remarks in relation to the work in question.

The enlargement of the harbour and the construction of the new south pier were the principal works which were stated as the grounds for a continuance of the passing toll, when the Harbour Bill was in Parliament in 1837. The benefit which shipping would derive from this was said to be great, but that the funds derived from the harbour-dues alone, chargeable upon ships entering the harbour, were insufficient to execute these improvements without the passing toll. This toll forms about two-thirds of the whole revenue of the commission.

If the repairs of the old south pier and other works, with the purchase and repair of mud lighters, and some deepening in the harbour, taken at say 700*l* per annum be deducted, the sum expended (as I presume) in finishing the north pier since the passing of the Act must have been nearly 19,000*l*. Now the north pier, although a great ornament to the town, is alone of little or no use to shipping taking shelter in the harbour, and yet, nearly the whole (including the debt) has been paid, or is to be paid, in the shape of passing toll. This retrospect is of little use, unless to show the expediency of now applying all the resources to the great work, and letting those who have paid and are to pay have, as soon as may be, the advantages that were held out; and I beg to repeat, what I have before said, that the most expeditious and certain way, as respects time and cost, is to have the work executed according to a specification by a respectable contractor, who will engage to complete it within a certain time for a gross sum.

The completion of the works will, it may be observed, tend to increase materially the trade of the place, consequently the harbour-dues and wharfage-rates.

I trust therefore that some resolution will be come to on the 26th which will in a few years produce a justification of the evidence which the witnesses, of whom I was one, gave in 1837 in favour of the Bill, and of the good effects which the shipping would derive from the harbour when enlarged and deepened.

I am, &c.,
James Walker.

To Sydney Taylor, Esq., Clerk to the Commissioners.

APPENDIX B.

HULL.
River Humber.

No. 215.
Evidence taken on the 22nd Oct., 1845.

No. 215.

PORT OF HULL.—RIVER HUMBER.

Examining Commissioners—A. CHAPMAN, Esq., M.P., and Capt. WASHINGTON, R.N.

Present:—The MAYOR, the TOWN CLERK, and Mr. THORPE, *Surveyor*, representing the Corporation of the Town; JAMES HENWOOD, Esq., *Deputy Chairman*. THOMAS BENTLEY LOCKE, Esq., *Director*, Mr. WM. H. HUFFAM, *Secretary of the Hull Dock Company*; JOHN HALL, Esq., *one of the Elder Brethren of the Trinity House*; Mr. EDWARD WILSON, *Solicitor*; Mr. JAMES OLDHAM, C.E.; Mr. BEE, *the Trinity House Buoy Master*; Mr. MANGER, *the Harbour Master*; JAMES SPRATT, Esq., *Chairman of the Commissioners of Humber Pilotage*; Mr. DALE BROWN, *Commodore of Humber Pilots*; and Mr. LUNDY, *one of the senior pilots of the port*; Alderman THOMPSON, *Chairman*; Mr. HASSELL, Mr. G. G. KEMP, *and other Directors of the Hull Chamber of Commerce*; JOHN SMITH, Esq., of Welton Garth, *Chairman*, SAMUEL TALBOT HASSELL, Esq., CHRISTOPHER RINGROSE, Esq., WILLIAM LAVERACK, Esq., J. M. KEIGHLEY, Esq., &c., *Harbour side Proprietors*; Dr. SANDWITH, J. K. WATSON, Esq., &c.

(*The Admiralty Charts, and Mr. Hall's Chart of the Humber, together with plans of the docks and river frontage at Hull, were laid on the table.*)

Mr. THOMAS THOMPSON, Town Clerk, examined.—Under the charter of one of the former sovereigns, the corporation are owners of the soil of the port of Hull, from Sculcoates Gote to the mid-stream of the Humber; the corporation do not claim to be the conservators of the navigation of the rivers Hull and Humber. The corporation receive dues as owners of the franchise of the soil of the port, but for the particulars of these must refer to Mr. Prissick, the water-bailiff, or Mr. Bolton, the treasurer.

Alderman THOMAS THOMPSON handed in a copy of the printed accounts of the Corporation of Hull, from the 1st of September, 1844, to the 1st of September, 1845, containing the accounts of the water-bailiff, with a list of the articles the water-bailiff's dues are levied upon, and the rate upon each. The receipts for one year were as follows:—water-bailiff dues, for goods, 2846*l.* 6*s.* 1*d.*; for "jettage," 1349*l.* 15*s.* 10*d.*; for anchorage, 667*l.* 10*s.* 3*d.*, (viz. in Hull 414*l.* 7*s.* 5*d.*, and up the rivers, 263*l.* 2*s.* 10.); for hostage, 60*l.* 17*s.* 4*d.*; for ballast, 2*l.* 18*s.* 4*d.*; making a total of 7074*l.* 9*s.* 4*d.*, and leaving, after the payment of salaries, commission, &c., a clear income on the year of 6552*l.* 16*s.* 10*d.*

The TOWN CLERK.—Although I cannot inform the Commissioners the amount of these dues, or exactly their application—which being a matter of accounts does not come under my notice, I can say how the corporation came into the receipt of them. The port of Hull was a port belonging to the Crown. In the reign of Richard II., the Crown granted the port by charter to this corporation, and since that time, these dues, which previously belonged to the Crown, have always been received by the corporation.

From September, 1844, to September, 1845, 7074*l.* 9*s.* 4*d.* was received by the corporation as port dues, payable on goods and shipping. If the importer be a freeman, and the goods be imported in British ships, and on his own account, then he is exempt.

The following is from the charter of Richard II., made in the fifth year of his reign, by which His Majesty, for himself, his heirs, and successors, granted "to the mayor, bailiffs, and burgesses of Kingston-upon-Hull, and their heirs and successors, in amelioration of the same town, that they and their heirs and successors may have a port under the same town, formerly called Sayer Creek, now called Hull, and next to the town aforesaid and liberty of the same, from Sculcoates-Gote unto the middle course of the water of the Humber, for ever, so that they and every of them may build houses, quays, and rafts within the same water, in amendment, defence, safety, and increase of the town aforesaid, and without impeachment of us, our heirs," &c. There were in and prior to the reign of Richard II. certain dues payable to the Crown, and there were in the same reign of Richard II. certain persons exempted from the payment of the same, among whom were the burgesses of Hull, and I believe of York also, and some other places. Those dues, up to the date of this charter, were received by the Crown, but from the date of the charter were begun to be received by the corporation, and have been received by the corporation on their own account ever since.

On one occasion Mr. Horner tested them, he thinking that they had originated with the charter of Richard II., and that thus having originated within the legal memory of man, they could not be enforced by law, The issue was joined at York, and afterwards removed to the King's Bench, but it was found that they were "ancient" dues or rights of the Crown, which had not originated in the time of Richard II. or within the legal memory, and therefore could be enforced.

COMMISSIONERS.—Is there any part of the receipts from this source, namely, 7000*l.* a year from port dues, laid out in improvements of the port.

TOWN CLERK.—The port dues were granted for the general amelioration of "the town." The corporation occasionally put down posts for the mooring of vessels, but they feel bound to do nothing. Whose duty it is to attend to the port is a point which is likely soon to come under litigation. Some years ago, there was a cranch near the mouth of the old harbour, which it was considered desirable should be removed. The corporation denied their responsibility to remove it. Ultimately the dock company and the corporation removed it without prejudice to either party. The proportion paid by the corporation was several hundreds of pounds. The dock company paid another proportion, it being admitted that the company was not thereby prejudiced. As conservators of the port, I am not aware that the corporation have removed any other obstructions to the navigation; indeed they deny the liability, but as owners of the soil of the port of Hull, they have removed and caused other parties to remove posts, &c., which had been put down in the river. There is no separation of jettage and anchorage from the general account; all go into the general fund, and there is no responsibility felt to do any particular thing with the money arising from port dues. Anything that is done is paid out of the borough fund, and may as well be said to be paid out of the market tolls, or any other description of income, as from these port dues.

Alderman THOMPSON.—There is something expended for jettage; the surveyor will know about it.

TOWN CLERK.—These port dues were granted to the corporation "in amelioration of the town;" part of them were applicable for the paving of the streets—the corporation finding stones and gravel; no part was applicable for lighting, which was managed by other local bodies; it was applicable, in

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Evidence taken on the 22nd Oct., 1845.

fact, to the same purposes as the borough fund, and a borough rate, if there were any, but there had been no borough rate for many years, and the whole of the moneys applicable as borough funds were raised in the manner stated in the printed accounts of the corporation published a few days ago in the local newspapers, and a copy of which had been handed to the Commissioners.

COMMISSIONER.—I see in these general accounts of the corporation a charge of 318*l.* for opposing the Hull Docks Bill. Have the corporation any reason to complain of the manner in which the docks at Hull are managed?

TOWN CLERK.—The corporation did not complain of the management of the docks under the Old Dock Act. But when the dock company was going to parliament with another bill, for powers to make another dock or docks, and that bill sought to confer upon the Hull dock company new powers, which the company had not previously possessed, and which were likely to be injurious to the property of the corporation—the corporation then, in conjunction with other parties who felt aggrieved, opposed certain clauses of the bill. Some parts of the opposed clauses were altered, some parts were withdrawn or thrown out, and as to some other parts the company persevered and obtained them. I should state that it was not the corporation alone that opposed the bill, or that felt aggrieved by it. They were joined by the merchants and shipowners of the port: indeed a general meeting of the town was held, at which it was agreed what parts of the bill should be opposed, and the corporation voted so much money as they thought proper towards the expense of that opposition. The works of both docks are commenced, and the railway dock is in a forward state.

With reference to the clauses of the various Acts relating to the cleansing of the harbour, I would observe that an ancient privilege of the corporation founded upon the charter of Charles II., the governing charter, was put an end to by the Dock Acts. Nearly the last clause of the charter states that it is and was a custom, that every merchant who within the waters of the Humber shall come with vessels and merchandize, and there shall lay and land, shall do so on certain staiths, belonging to the Corporation, and not in any other place, excepting such as are citizens of York, who shall be at liberty to proceed to York. The Dock Act put an end to these privileges by allowing persons in general to erect wharfs and land goods.

The clause is the last but one in the charter, which is given at length in Gawtress's Report of the Municipal Inquiry at Hull, in 1834, pages 23 to 40. The clause is side-headed thus,—"Ancient custom that every merchant shall unlade his goods at ancient staith, except citizens or inhabitants of York; the King wills the same custom to be observed for supportations of burthens and expenses of Mayor, &c., in repairing banks and jetties."

The first Dock Act, the 14th Geo. III., c. 56, enabled his Majesty to allow of certain wharfs being built; it provided that they should not extend more than fifteen feet into the river Hull; that such landing places, quays, or wharfs, should be built upon not more than two rows of piles, which should be left open for the tide to pass through, and should be kept in an efficient state for the navigation. [The Town Clerk proceeded to read the clauses, both as to the building of the quays and the form of the banks of the river.]

Sec. 1.—King may appoint quays on west side of the havens, for landing foreign goods.

Sec. 2.—Not to extend beyond 15 feet into the haven.

Sec. 3.—Proprietors may build quays on piles, to project 15 feet.

Sec. 5 stipulates the number of rows of piles.

Sec. 6.—"Provided always, and be it enacted, that all and every the proprietors of the said staiths shall, and they are hereby required, within 18 calendar months after the first sufferance quay or wharf shall have been erected or built, in pursuance of this Act, to cleanse, scour, open, deepen, widen, or cut through and take away, at their own costs and charges, all banks, hills, earth, soil, or rubbish, beyond 35 feet from the uttermost part of the staiths or warehouses already built and erected upon the west side of the haven of the said river Hull, as low as low-water mark, from Thomas Walton's ship-yard to Rotten Herring staith; and also to make and preserve the beach in such a manner that the same may slope or batter two feet at least for every foot of perpendicular rise from the said low water mark in the said haven, to within 15 feet of the present staiths or warehouses, and so as at the level of the ground, without the said distance of 35 feet from the present staiths or warehouses, shall be equal in a line or height with the said low water mark."

There are also clauses (the 7th, 8th, and 9th) as to how the low water mark is to be obtained.

Sec. 10.—If sec. 6 is not attended to, the commissioners may cleanse the haven and levy costs on the adjacent proprietors to pay the expenses.

Clause 11 was also referred to.

It was enacted that the line was to be fixed within 12 months after the passing of the Act, but I am not aware that it ever was fixed, nor am I aware of any standard. The water now cleanses the harbour, if that can be called cleansing. At one time there was a good water scour; before the making of the docks, there used to be so many vessels moored in tiers of three or four abreast, that they made a complete line, or series of lines, through which the water passed with considerable force between the vessels at ebb-tide, and so scoured the haven; but since the docks were made fewer vessels resort to the harbour, the scour is less complete between them, and mud accumulates. Another cause has contributed to this; a very large quantity of water used to come down the Sutton drain, for a large portion of which the drainage commissioners have now provided another outlet, and thus there is considerably less water coming down the river to scour it;—besides which we have had several very dry summers, affording us less water from the river and the other drains and natural streams which empty themselves into it. There is another clause (the 87th) which empowers the dock commissioners named in that Act, within three days after notice from the Holderness drainage commissioners of an obstruction in the haven, to cause the same to be removed.

The corporation have contributed towards making the docks.

They took shares in the dock company; they also contributed 58,250*l.*, or one fourth part of the entire cost, 233,000*l.*, of making the Humber dock.

[The representatives of the dock company here intimated that the corporation had received some compensation for this expenditure; and a conversation ensued upon the point between Mr. Henwood and the Town Clerk, from which it appeared that, at the time when this dock was wanted making, and the dock company, the corporation of the town, and the corporation of the Trinity House,—all deeply interested in the increase of the shipping business of the port, were desirous of its being made, public confidence in the profitableness of such undertakings was much lower than at present, and difficulty was experienced in raising the means, which was at length overcome by the dock company

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guaranteeing one half of the expense, and the corporations of the town and of the Trinity House the other half in equal parts between them. But that to compensate the Trinity House and the corporation, the government gave to them a stripe of land on the east side of the river, upon which military works had stood, with liberty to sell the same and refund themselves the amount expended. The bargain, however, turned out a great loss to both the corporations, the dock costing double the estimates. The Town Clerk intimated that the portion of the expense actually contributed by the corporation of the town was much greater even than Mr. Henwood made it out to be, for he had in his possession the deeds of conveyance by which the corporation purchased this very ground for the purpose of military works being erected upon it. Therefore, he said, the government had given to the corporation that which was its own, but had moreover admitted another body or bodies to participate therein. For he was of opinion, that although while the military works stood, the King alone had the right to use them, yet the fee remained in the corporation, whose ground and buildings they were, although occupied by the King. The same was, he said, the case with respect to the sites of the old, the junction, and the Humber docks. The corporation were large contributors to them all, for the ground of the old fortifications given by the government to the dock company, as sites and materials for these docks, were doubtless the property of the corporation]

They have contributed materially to the advantage of the port, both by money and otherwise. They have removed banks, piles, and other obstructions to the navigation of the haven.

There were three jetties on the garrison side of the harbour, which they caused to be removed.

In brief, the corporation puts down mooring posts constantly on the west side of the river, removes piles from the navigation, and has obliged parties to remove piles which they had planted, and sand, and any other thing deposited obstructive to the navigation.

The next Act relating to the cleansing of the river is the 45 George III., c. 45, another Dock Act, the 5th section of which (marked 9th in Wooley,) enacts that it shall be lawful for the dock company (and not the dock commissioners who were named before) to scour, &c., the said haven. The clause is as follows:—"And be it further enacted, that it shall be lawful for the said company, their agents, servants, or workmen, as often as occasion shall require, well and sufficiently to cleanse, scour, open, deepen, widen, or cut through, and take away any banks, hills, earth, soil, or rubbish, in the said haven, docks, or basins, or near the entrance or entrances thereto, in such manner as the said company shall think proper, for the convenient entrance of shipping into the said haven, docks, or basins respectively, and their security and accommodation therein, and for the more free passage of water in the said haven; and also to remove and take away any wrecks of ships or vessels, or any ship or vessel that shall be sunk, or any wood, timber, stones, anchors, or other obstructions or impediments of the like nature in the said haven, docks, or basins respectively, or near the entrance or entrances thereto, that may be found to arise therein respectively; and in case the owner or owners of any such wrecks, ship, or vessel, or other obstruction so to be removed, shall refuse or neglect to pay the charge of removing the same, for the space of three days after demand thereof made by any officer of the said company, then the owner or owners of any such wrecks of ships or vessels, or any ship or vessel that shall be sunk therein, or any wood, timber, stones, anchors, or other obstructions or impediments of the like nature, shall for every such offence forfeit (exclusive of the expenses incurred by removing the same) the sum of five pounds, and the same shall be recovered and applied in such manner as other penalties and forfeitures are by the said last hereinbefore recited Act directed to be recovered and applied."

Mr. HUFFAM said that clause was inserted to give the company power to keep open a good passage to the old dock, otherwise the passage to that dock might have been stopped up by craft or other things in the harbour. It is a permissive and not a compulsory power.

TOWN CLERK.—The term is "lawful;" and that is one question which has to be decided, what is the meaning of the word "lawful." It may mean that they shall do what the law requires. On the other hand, it may be contended that it merely permits a party to do what the law does not forbid.

There is yet another clause, which is in the 229th section of the last Dock Act, the 7th and 8th Victoria (1844), c. 103, which confers the power upon the new dock commissioners.

The corporation of the Trinity House took an opinion, and I may state that I have seen an opinion of the Recorder on this subject; but there were materials omitted in the case submitted to him, which I say ought to have been brought under his notice and were not, and which, had they been inserted, would, in my opinion, have made a material difference in the Recorder's opinion. This is the clause just mentioned:—"And whereas by the first-recited Act power is given to the commissioners therein named to compel the proprietors of staiths to slope, cleanse, scour, open, deepen, widen, cut through, and take away banks, hills, earth, soil, or rubbish, and preserve the beach within the said haven, and a like power is given, after notice or complaint in writing from the trustees of the Holderness drainage, or any five or more of them, for the said commissioners from time to time to cleanse, scour, open, deepen, widen, or cut through and take away all banks, hills, earth, soil, or rubbish, and to enforce payment of the penalties or sums to be paid on default by the said proprietors, and it is expedient that such powers should be continued by this Act to the commissioners hereby appointed; be it therefore enacted, that the said powers and authorities hereinbefore specified shall hereafter be executed and enforced (as the case may require) by the said last-mentioned ommissioners in as full and ample a manner as if the said commissioners had been named in the said firstly-recited Act, instead of the commissioners by the said firstly-recited Act appointed, and as if the same powers and authorities were repeated herein as applying to the commissioners by this Act appointed."

Mr. HUFFAM wished to ask the Town Clerk, whether he had not himself given a decided opinion that it was the duty of the corporation to cleanse the harbour.

TOWN CLERK.—I was solicitor to certain gentlemen who wished the thing to be done, but not at their expense, and I then contended that it was the duty of the corporation to cleanse the harbour. I am now solicitor to the corporation, and am fully prepared to contend that it is not their incumbent duty so to do.

The limits of the port over which the corporation claimed the ownership of the soil were those described in the charter of Richard II., viz., from Sculcoates-gote to the mid-stream of the Humber; but that the franchise of the port, which was also given by the Crown to the corporation, was co-extensive with the utmost limits of the borough, which had been from time to time altered.

COMMISSIONERS.—If we understand rightly, the corporation claim the right of the soil as far as the mid-stream of the Humber, so that if any persons were to do, or attempt to do, anything which would cause shoals to accumulate in any place short of the mid-stream, the corporation have the power to prevent them.

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Town Clerk.—No; it is our soil, but other parties have the right, by Act of parliament, to remove obstructions to the navigation, as stated in the clauses submitted just now to the Commissioners. We have not as owners any right to obstruct the navigation.

Commissioner.—Does not the grant of the port include the responsibility to cleanse the same?

Town Clerk.—The interest of the corporation may very frequently induce them to do so, but I am not aware of any responsibility.

Mr. Hassell wished the Town Clerk to be asked, whether the corporation claimed to be owners of the port up to the Beer Houses, 4 miles above Hull. Mr Hassell stated that he wished this question to be asked, because there was a large trade carried on by the various manufacturers on the river Hull, above the bridge, and which part of the river was not included in the "old harbour;" that it was desirable to know who were the parties bound to attend to the navigation of it, and whether the extension of the borough and the rights of the dock company, as to deriving dock dues, had made any alteration in the conservatory power over that part of the river.

Town Clerk.—My present impression is that we are owners of "the franchise" of the port to any extent, but we have no right to the soil beyond the Charter House. In some ports the franchise is in one party and the soil in another. Here they are both in one—the corporation. The Crown has sometimes granted the soil and reserved the franchise, but in the case of the corporation of Hull both were granted.

Commissioner.—Are you aware that the 54th of Geo. III. c. 159, prevents any person from building in any of the navigable rivers or harbours of the kingdom below high water mark of ordinary spring tides?

Town Clerk.—Yes; I am aware that by the statutes 19th Geo. II., c. 22, the 46th Geo. III., c. 153, and the 54th Geo. III., c. 159, they are prohibited under certain conditions; they must give a month's notice of their intention to the Admiralty; if within that time the Admiralty object, the party cannot build at all. If the Admiralty give no notice within that time they cannot interfere afterwards. The corporation has received several complaints as to the state of the harbour within the last two years—the last within a fortnight. Such complaints would be entered upon the minutes of the corporation. The dock company had on one occasion emptied their mud barges in the river Hull, in that part called the old harbour.

Mr. Huffam.—The particulars of this were stated in the evidence before the committee of the House of Commons, on the Hull Dock Bill, in 1840, when it was proved that those barges had been so emptied once, because the navigation of the river was then so obstructed that the barges could not get out to the Humber.

Town Clerk.—In the removing of piles, or other obstructions, the corporation did not think that they did so as conservators of the navigation; the prosecution referred to by Mr. Hassell, against a party for placing stones in the river, was by the Garrison Ground Committee; but Mr. Malam asked and received from the corporation permission to lay his gas-pipes under the bed of the river; all this was done as owners and not as conservators; the corporation, under the last Dock Act, do levy port dues as high up the river as the Beer Houses, and, in fact, throughout the whole port of Hull, which once included York (now given to Goole;) the Trent was till lately within the port, but now belongs to Gainsborough; Bridlington is still within the port; the local port dues are not received excepting in the cases of vessels which land goods; the port is, in fact, a free port of refuge, so far as this corporation is concerned, but he was not sure whether the Trinity House was not entitled to some dues for lights, &c.

Alderman Thompson wished to explain, on behalf of the corporation, that a very small portion of the water-bailiff's dues is received at Goole and Gainsborough. The Commissioners would observe that, in 1844-5, for anchorage 263*l.* was received up the rivers, and 414*l.* in Hull.

Ald. Thompson stated—I am President of the Chamber of Commerce for the present year. The chamber had met, and agreed to a document, containing such information as lay within their reach, and which they conceived would be of service to the Commission.

No. 216.

Statement of the Chamber of Commerce.

No. 216.

Statement of the Chamber of Commerce of Hull.

"The town of Hull is situated at the confluence of the Hull with the Humber, both of which rivers form the port with the docks communicating. That part of the port not within the docks is without a guardian power.

"The parties having controul at the port are, the municipal corporation; the corporation of the Trinity House; the dock company and dock commissioners; the pilot commissioners; the commissioners of the Holderness drainage.

"The mayor is admiral of the Humber. The corporation receives dues from all vessels using the port for jettage and anchorage. They also own the ferry-boat dock for market vessels, and are proprietors of the soil of that portion of the river Hull forming the harbour, on which are situated warehouses and timber yards.

"The corporation of the Trinity House buoy and light the Humber, and license pilots. All vessels pay buoyage, and a primage is paid on the cargoes from foreign. They also appoint the dock and harbour masters.

"The dock company are owners of all the wet docks, and receive dues from all vessels using the port, whether going into the docks or not, except those from the East Indies, &c., and vessels in distress that do not use the docks. The commissioners have the controul of the management of the docks and quays.

"The pilot commissioners have the superintendence of the pilots and ballast lighters. All vessels not under six feet draught of water must pay pilotage.

"The Holderness drainage commissioners have the right of giving notice to the dock commissioners to remove banks, hills, earth, soil, or rubbish in the harbour to low water mark.

"Both the rivers Hull and Humber have considerably warped up, to the injury of the navigation. It is proved in evidence before the House of Commons that the dock company's mud boats have deposited their contents in both rivers, and that it is now regularly done in the Humber to the extent of several thousand tons per week. To this is attributed the large increase of the shoals in the river Humber, above, opposite, and below the port of Hull; and in the river Hull deposits and projections have been made much encroaching on its width and depth.

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"Various works within the present century have been formed on the Humber, encroaching on its bed. Its flow opposite the town was up to Humber-street. The Dock Bill of 1802 permitted the works being carried out to low water mark, which was ascertained by the Trinity House, but the lock pit and jetties of the Humber dock were carried out beyond that line, thus aiding the accumulation of mud to the eastward, at the entrance of the Hull, and opposite the citadel. The Dock Bill of 1844 has given powers for further extensive projections into the Humber, to the eastward of the Citadel."

(Signed) "THOMAS THOMPSON,
"*President of the Chamber of Commerce.*"

The TOWN CLERK was re-called, and requested to explain the nature of the dock commissioners' duties and powers, and whether they had the right to summon parties for obstructing the navigation. He stated that the Holderness drainage commissioners had alone the power to complain. They were afraid that the opening of the docks might in some way cause or lead to obstructions in the river, which would prevent the proper discharge of their waters. But they had now got another outlet for part of those waters, and, he feared, cared little about the matter now. On their complaint the dock commissioners, under the first Act, and the dock company, under the second Act, were to cause the removal of the obstructions; but the drainage commissioners never complained.

COMMISSIONERS.—The first party named as having the controul of the navigation is the municipal corporation. To what extent do their powers go?

Ald. THOMPSON explained that the Humber frontage of the port was formerly entirely open; that on the making of the Humber dock, the works were permitted to be carried out considerably into the Humber; that Humber-street faced the Humber, and Ald. T. himself had landed at a jetty which stood where the principal entrance of the Victoria-rooms now stands, and that the whole of the ground southward of that point was made of the excavations from the Humber Dock; that, at that time, about 1802, an Act was obtained to enable the corporation to make a ferry-boat dock, the new ground in question being made for the purpose both of making the dock, and of selling the remainder for building purposes; that the dock was intended to have occupied a space more inland than it does, now covered by Queen-street and Nelson-street, but ultimately it was made in the form in which it now exists; that many complaints had, from time to time, been made of the insufficiency of the accommodation in the ferry-boat dock, and that he himself had given information and complaint as to its warping up. That there is a great difference of opinion as to what are market and ferry boats; but he might also add that there is great difficulty in keeping the ferry-boat dock, circumscribed as it is, in an efficient state, from a great tendency and constant subjection to warping up of the entrance of the harbour. That many plans have been devised for improving the ferry-boat dock, and the corporation have recently asked an eminent engineer for a plan, which has not yet been received. He himself had always contended that the outer portion of the the works, now bounded by the breakwater jetty, should be carried out so far as to be parallel with the outer part of the dock company's works.

TOWN CLERK.—The statute relating to this dock is the 41st Geo. III., c. 65, in which it is recited that it would be for the advantage of the town and port if a ferry-boat dock were provided, and it is enacted that on the same being paid for, the land should become the property of the corporation. Then it was enacted, that as soon as the dock was made, all the ferry and market-boats, which had used to resort to the old harbour, where the landing and mooring had become dangerous, should come into this dock free of charge. It was remarkable that there was in the Act no compulsory power to compel any party to make the dock, but the inference was that it would be made. There is a clause for the remuneration of a person for taking care of the gates, but it was remarkable that no gates were ever made. There are no dues payable for the use of this dock. The corporation made it free for the ferry and market boats.

They were owners of the Barton ferry, the boats of which needed accommodation, and that induced them to see to the making of this dock.

COMMISSIONERS.—Who threw out this projection, viz., the site of the battery, at Old-south-end, in front of the east end of Humber-street.

TOWN CLERK.—That was the property of the corporation, but in troublous times Col. Malouverer took possession, and it has ever since remained in the hands of the government.

COMMISSIONERS.—Would it not be better that the harbour frontage of this (Old-south-end) property should be brought out into one fair straight line?

Ald. THOMPSON.—Lately it has been improved in that way; it has been very much straightened on the making of the new graving dock, but the entrance of the graving dock being in the corner to which you allude, it is not practicable to fill that up. The decreased nook which is still left along side the graving dock is shallow, and used by coal vessels.

Mr. HENWOOD drew attention to a clause in the Ferry-boat Dock Act, which gave the corporation power to lay out a new street, and also to make a suitable ferry-boat dock.

TOWN CLERK.—It is so.

The traffic resorting to this dock had greatly increased, although he could not say that that of the particular description of boats for which it was made had done so, for at that time he believed the only ferry-boat was the Barton; the New Holland steamer, which had since arisen, was not properly a ferry-boat, nor was Grimshy a ferry.

Mr. SMITH.—The numerous market boats which used to come down the rivers, once a fortnight, on full boat days, have almost altogether ceased since the establishment of the daily steam packets, but suitable accommodation is not provided for them.

The TOWN CLERK admitted that better landing places needed making for the steam and other passenger vessels. But the corporation did all that they were empowered to do by the Ferry Dock Act, and to do more they must have a new Act.

Ald. THOMPSON.—My opinion is that the present dock can be greatly improved. I would form a bridge from Nelson-street to the breakwater, which I have stated ought to be carried out parallel with the dock company's outer works, and there have a floating cassoon attached to the breakwater, which would then serve as a landing place at all states of the tide. The corporation has ordered a plan to be made with the view of carrying out this improvement. There ought to be a straight low water line in front of the port, both east and west of the harbour.

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Mr. SMITH.—I am very glad to hear Alderman Thompson expressing so much attention to the navigation. But I should like to ask him if the corporation have not recently intruded into the river Hull at its mouth, and made an encroachment, by extending the works of their graving dock?

Ald. THOMPSON.—That is a matter of opinion. My opinion is, that it will assist the tide to scour the haven by cutting off a corner. There is a plan by Mr. Rendel for converting the old haven into a dock, and also for a breakwater.

The works of the dock company (the Humber dock piers), which project into the river, contribute to warp up the foreshore, as every projection tends to warp up the foreshore east and west of it; but not so much as formerly, since the dock company converted them into open piers

When there was a great trade in the harbour, 20 years ago, there was a better scour than now; but the haven has considerably warped up since the opening of the Junction dock, in 1829; (the Humber dock was opened in 1809, and the old dock in 1788).

There are strips of land formed by the warping for a considerable distance; besides which I have seen beds formed by the laying of particular ships in particular berths, so that a bank has risen head and stern of the vessel, which has remained and greatly impeded the navigation.

A ship of 17 feet draft cannot now come up to the old dock at highwater at neap tides, but could have done so before. It would contribute to the improvement of the old harbour if the "ways" were removed, the piers of the bridges opened up, and the strength of the tide directed through them; but I think that would not be sufficient. There would still be the banks and hills, and, in fact, these very places would be liable to receive again deposits.

Mr. LAVERACK.—Some of the hills are 20 feet above the bed of the river; no dredging machine would remove them; and this state of things increases. The tide does not always cover some of those hills, and I cannot get a ship to my quay for some of them.

Ald. THOMPSON.—That is entirely your own fault. It was your duty to keep the navigation in an efficient state, and you knew it. It was your interest also.

The amount received by the dock company, in 1841, was 48,000*l.*, but they have got a great many things to do with it. The tonnage dues on shipping are their greatest source of revenue. And as to the dock company, a great responsibility must rest upon them; they receive dues upon the vessels which enter the harbour and do not use the docks; now, if the harbour were not there, they would have to provide more docks; therefore it is their interest also to keep the harbour in an efficient state.

COMMISSIONER.—Is not one fourth part of their gross receipts derived from the old harbour?

Mr. HUFFAM.—No, it has been ascertained to be 2300*l.* a year; or about one-twentieth part of all the vessels which enter the port do not use the docks. All the vessels from the rivers westward are entirely free from dock dues, and a great portion of the craft using the harbour only is of this description. Last year the dock dues amounted to 38,000*l.*

COMMISSIONER.—And it is in evidence that 7000*l.* a year are received by the corporation as water-bailiff dues. Thus we have a sum of 45,000*l.* a year levied as dues upon shipping (the surplus of which in all other ports would be applied to the improvement of shipping), besides the taxes paid to the Trinity House as primage.

Mr. JOHN HALL (one of the Elder Brethren).—The Trinity House receives various dues, such as buoyage and beaconage, which are expended upon the buoyage and lighting of the Humber. But there is also a toll or duty called primage, of 3*d.* a ton upon all goods imported and exported to or from foreign places. It is altogether expended, agreeably to the charters, for charitable purposes. I think the annual amount of that alone is 3000*l.* to 4000*l.* [The exact amount was afterwards furnished by Mr. Wilson. Last year it was 9297*l.*]

Ald. THOMPSON.—The corporation receives no tonnage dues upon shipping, and the dock company get more than three-fourths of the sum named.

Mr. HENWOOD.—And they make the docks.

Ald. THOMPSON.—The dock company never made the docks as they ought to have done, otherwise Goole and Gainsbrough would never have been made ports. They have never made docks until those in existence were crowded to excess, the ships cramped and damaged, and the trade of the port actually driven away for want of accommodation. They have never anticipated the trade, and provided for it. The docks belong to a private company, whose object has been to share a large dividend—in my opinion a most short-sighted policy, and it is one of the greatest injuries to the port, that of the docks being in the hands of private parties, whose eyes are rather to the dividend than the wants of the port.

Mr. HENWOOD.—And which private company passed a resolution to sell the docks to the town at a fair and reasonable price.

Ald. THOMPSON.—They did; and a committee of twenty-four was appointed, in the year 1836, to negociate with the dock company for the purchase of the docks. The company agreed to sell them, provided the corporation agreed to a guarantee to make up any deficiency in the annual interest upon the purchase money, in case the receipts from the docks should not be equal thereto—of which, in my opinion, there was very little fear. The corporation said "Yes, we will guarantee, provided the town will indemnify the corporation." A public meeting was called, which was largely attended by shopkeepers, who were afraid of a borough rate, and said, "we will limit the guarantee." The shopkeepers made a great muster, and we unfortunately lost the docks; we are unfortunately in that situation that we cannot have any increase of accommodation without asking a private company. If those docks had been in the hands of the town, we should have provided for the coming wants of the port, as is done at Liverpool.

Mr. HENWOOD.—The Town Clerk moved, and I seconded, the resolution that the town should have the docks.

Ald. THOMPSON.—Yes, the dock company behaved very handsomely. The shopkeepers, who did not understand the matter, made a great muster, and overruled the motion, and lost an opportunity which I fear they never will have again.

Mr. HASSELL.—A public body anticipates the wants of a town; a private one waits until the accommodation can no longer be withheld.

Ald. THOMPSON.—So much has this been the case at Hull, that, some years ago, vessels were sunk

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in the harbour from its over crowded state. It was so full that vessels could not get into it nor out for days and weeks together. The consequence was that the Leeds and West Riding manufacturers, whose goods were thus detained here, raised a clamour, and that was the cause of the Aire and Calder Company beginning to make Goole. There is no doubt, if we had made dock-room, Goole would never have been in existence.

Mr. HENWOOD.—The dock company had not been backward to give the accommodation, but had been opposed rather than aided by those who ought to have rendered every assistance. He noticed the extensive works now in progress, as proofs of their providing for the coming wants of the port.

Ald. THOMPSON.—It was impossible that the government would permit such a state of things as I have described to continue. I don't give them credit for anticipating the wants of the port. It was fear. There was no doubt that had they still declined making accommodation, the government would have given the power to other parties, who were willing to undertake the responsibility.

COMMISSIONER.—If more dock accommodation was wanted, how was it that you opposed the dock company when they offered to make a dock?

Ald. THOMPSON.—The dock company offered to make it in the wrong place—to the east of the river, whereas the chief want was of more docks in connexion with the railway. Mr Stephenson prepared a plan for making a railway dock alongside the railway. It was the natural place. But they went to the eastward—for what purpose I do not know, unless it were to get land cheap. I would have made docks all along the railway to Hessle, if required. I, however, did not oppose the making of a dock anywhere; but I opposed the wharfage clause, because I considered they had the means of making the docks without any new tax. And the proof that my calculations were right is found in the fact that the dock shares, which in 1840 were 1150*l.* have, in the face of a great outlay for new works, advanced in value 500*l.*, and are now 1650*l.*

Mr. HASSELL.—1700*l.*

Mr. HENWOOD suggested that the rise might be owing to the outward wharfage clause, which the company had obtained.

Ald. THOMPSON said he believed that the real cause of the rise was that the company were providing for the wants of the port accommodation, which would certainly be required, and, being required, would pay a good profit, as he had shown in his calculations, printed in the *Eastern Counties Herald* in 1840, wherein he showed that by laying out 300,000*l.*, according to a plan he then detailed, the value of the shares would rise, and by laying out 400,000*l.*, it would all be recovered in 22 years, and the dividends would be 150*l.*, instead of 60*l.*,—thus more than doubling the value of the property out of its own reserved profits in less than a quarter of a century.

COMMISSIONER.—This document states that the dock commissioners have control of the management of the docks and quays. Is it their duty to keep the quays in order?

Ald. THOMPSON.—They cannot be kept in order. There is more business in the port than the quays are sufficient to facilitate now. The locks are not sufficiently large; the gates chiefly are in as good order as the company can, perhaps, under the circumstances, make them. Two entrances to the Humber dock have been talked of, but one will probably be sufficient when the east dock is made.

Mr. HENWOOD.—The great object of the east dock was to remove the lumber trade (timber and deals) from the old and Junction docks.

COMMISSIONER.—If the timber is sent to the westward by the railway, would it not have been better to have landed it near to the railway station?

Mr. HENWOOD.—The eastern dock is chiefly for timber at present. The dock company wanted to make a west dock, but the great objection to that was the want of water. Mr Hartley, the company's consulting engineer, proposed the east dock as the most advantageously situate one, in point of depth of water and accessibility at the worst state of the tides. Hull is a port of transit, and it is one of the principal ports for the import of timber, which from Canada and the Baltic is very large; a portion of the timber is sent by railway into the manufacturing districts, and the quantity so sent is increasing.

Ald. THOMPSON.—It is an easy thing to bring the rails to the docks, but I am sorry to say that some obstacle to it has arisen within the last few days. An independent railway company was projected with the view of uniting the east dock with the railway system. This company was to have the support of the Manchester and Leeds Railway Company, Mr. Hudson having previously purchased the Hull and Selby Railway. But within the last few days, Mr. Hudson and the Manchester and Leeds Company have made peace, and the latter say "we will give up our support of the East Dock Railway, provided you admit us to an equal share in the Hull and Selby." This Mr. Hudson has agreed to.* The dock company did not intend to make a railway dock; but the railway companies, Mr. Hudson and the Manchester and Leeds, compelled them.

The size is an average length of 716 feet, and parallel width of 165 feet.

Mr. HENWOOD.—It will be opened in the spring, and will have quay-room equal to the Junction dock. It is 15 feet wider than stipulated for in the Act.

Ald. THOMPSON.—It is a mere bagatelle—quite insufficient for the trade. It ought to have gone much further. I showed them how they might have purchased Edward's-place, and gone through to Cogan-street. It will accommodate three steam packets on each side, and one steamer in the middle will block it up. This dock will not afford accommodation for the business which now exists. When the east dock is made, it will do very little to relieve it. What use will it be, when nearly the whole of the goods that go there will have to be sent to this dock in lighters. It will not accommodate even the steamers. We have three large steamers a week now from Hamburgh, besides those of other ports, and the number is increasing. When the east dock is made, the harbour will be more used than it is now.

Mr. HENWOOD.—When the east dock is made, and the Humber dock, the railway dock, and the Junction dock are supplied with rails, there will be a vastly increased and, I should say, ample accommodation for the import trade and the export trade in connexion with the rails.

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* The York and North Midland Railway Company, and the York, Hull, and East and West Yorkshire Railway Company, have each, since this inquiry, given notice of their intention to apply to Parliament in 1846, to make an east dock railway.

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Ald. Thompson.—It was a great mistake to make the east dock where it is. But it was a grasping at ground, and a desire to make the shares more valuable, that made the company go to the eastward.

Commissioner.—This statement next alludes to the drainage commissioners. What charge have they of the port?

Ald. Thompson —Their only office is to attend to the drainage of the country, which was most important at that day.

Commissioner.—Then the land would be better drained if the haven were cleansed. Is there no party whose duty it is to cleanse the haven?

Ald. Thompson.—The drainage commissioners should complain. The owners of staiths are bound by the Act of parliament to cleanse it, but they wish to make any body's pocket rather than their own pay for it.

Mr. Ringrose drew attention to Church-lane staith, which does not belong to any private owner, but at which one of the most formidable banks in all the river exists, and to the fact of the staithways being in the care of the corporation; and

Ald. Thompson expressed the readiness of the corporation to do everything that belongs to them.

Commissioner.—Would the harbour side proprietors object to a slight toll for cleansing and keeping the haven clean?

Mr. Laverack.—No.

Mr. Ringrose.—The harbour side proprietors say that the dock company and the corporation ought to cleanse it.

Ald. Thompson.—The owners of property were named as the parties, in the Act which gave them permission to erect quays in the river.

Mr. Laverack.—The navigation is impeded, and in some parts altogether suspended. I cannot get my ships to their berth.

Mr. Keighley (who is both a harbour side proprietor and a dock director) said—There is one bank, at Church-lane, 21 feet high above the bed of the river. I wish you could see it. It is quite enough to break the back of a ship.

Commissioner.—I have seen and examined them all. Now as to the emptying of the dock company's barges.

Ald. Thompson. —It is regularly done in the Humber, to the extent of about 100,000 tons per annum. For two or three months, in consequence of the barges being emptied at high water, and the bargemen being anxious to take out the barges and bring them back into the dock on the top of the same tide, so that they may not to have to pen them through the locks, they have gone into the Humber short of the mid-stream, and have emptied the barges in Hull roads instead of upon the south side of the middle sand.

Commissioners —Do you think that any mud should be emptied in the Humber at all?

Ald. Thompson.—I think not, but if it were carried out into the mid-stream when the tide is going down, it might float away from opposite the entrance of the port. But as it is at present done that is impossible. It is carried out opposite the entrance of the port, and there deposited a little before the top of high-water, so that it is immediately carried back into the docks, and into the haven, or a portion of it deposits upon the sand and increases the shoal. It is very soft, deposits very quick, and soon becomes very solid. There is no question it goes into the harbour, to a very great extent, and along the front of the entrances.

Dr. Sandwith.—It is a great pity that it should be wasted, as it is good for manure, and extremely fertile. I have seen an analysis of it.*

Commissioner.—Could it not be laid on land, by depositing it at high water upon the foreshore above low water mark?

Mr. Huffam.—The enclosure for its reception would require piling. There is no doubt, if the owners of property on the foreshore thought it worth preserving, it could be done. But they could not sell it as manure.

Ald. Thompson.—There are plenty of owners of ground who would be extremely glad of the opportunity of being permitted to preserve it.

Dr. Sandwith.—I know that it would be good for manure.

Ald Thompson.—It would upon a gravelly soil. But in Holderness the whole soil is an alluvial deposit of the same nature, and it certainly would not be worth leading there.

Mr. Huffam.—It would do for the light soils but not for the heavy.

Mr. Kemp.—There have been several instances of its being wheeled over the Humber bank for the sake of improving the soil in the immediate vicinity.

Ald. Thompson.—Every projection is injurious to the navigation, as it encourages the deposit of mud, and prevents that clean scour which the tide would have on the face of a straight foreshore. The railway company is doing something to improve the Humber frontage of the town, by enclosing and

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* In February, 1844, the following analysis of the mud of the Humber was made by Wm. Sharp, Esq., F.R.S., and given in a paper read to the Hull Philosophical Society on the 9th January, 1845, in which Mr. Sharp suggested the double advantage which would be derived from ceasing to throw the mud dredged from the docks into the Humber, by which the navigation of the river, it would appear, must necessarily be injured, and by casting the mud so collected on to the adjoining land, by which the soil would be improved:—Organic matter, 3; silica, 50; alumina, 12; carbonate of lime, 17; carbonate of magnesia, 8; peroxide of iron, 3; peroxide of manganese, sulphate of potash, and sulphate of lime, 3; phosphate of lime and iron, 2; chloride of sodium, 2; Total, 100. On being requested to furnish this analysis (Nov. 15th, 1845) for this report, Mr. Sharp observed that the analysis made two years ago was tentative and gives only an approximation, and that the mud was collected on the Humber bank, and was not that taken out of the docks. It was sufficient, however, to found upon it the above suggestions, made and strongly recommended to the notice of the dock company and other parties interested. Mr. Sharp has no doubt that the mud taken out of the docks would be considerably more fertilizing to land than that actually analysed, and he would rejoice to see the subject thoroughly investigated, and to find that degree of attention directed to it which, in his opinion, it justly deserves.

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banking up the foreshore in a straight line. They have got nearly the entire Humber frontage of the port into their possession, which is a great misfortune for the town; there are scarcely any ship-yards there, and none can be made. It is a fact, that an iron ship-building establishment exists in that part of the town, but they have no river frontage, and can get none sufficient to build their ships upon, so that they actually have to be drawn on trucks, in pieces, from the manufactory, across the railway, and then put together again and so launched. It is a great misfortune to the town, and almost the destruction of the sites where ship-building, boiler-making, and various manufacturing establishments would have been carried on.

Mr. HENWOOD.—Mr. Liddell and I did all we could to prevent the railway being brought along the foreshore.

COMMISSIONERS.—Should not an engineer on behalf of the port have been consulted in the laying out of these works?

Ald. THOMPSON.—Undoubtedly there should be such an officer, but there were none on behalf of the port. A great deal of the mud would be removed if a continuous line of quays were thrown out, so as to give the current a more direct course, and we should get more into the line of the east dock. I believe the dock company do not intend to go so low with their stone work as is described upon their plans, but to construct open piers. The only way to have caused and preserved deep water close up to the entrances of the port would have been to have constructed the whole of the works in a line. But to effect this thoroughly, it would have been necessary to have formed an embankment in front of the citadel.

Mr. HUFFAM.—Mr. Hartley's plan to effect this object is before you, but the government said that no embankment should take place. The company proposed to make a dock on the site of the citadel, but the government ask such a price for it that the company found they could not do it. They, therefore, went to the east of the citadel, where they propose to carry out their works to low water mark. It was necessary for us to go to low water mark in order to get the depth of water. The dock company have determined to make part of their outer works of stone, and that the rest shall be open piers, preserving a channel, by sluicing, to low water mark. At Liverpool, Leith, London, and Bristol, the dues on shipping are higher than at Hull, as was proved before the committee of the House of Commons.

Ald. THOMPSON.—I have paid 9*d.* per ton from South America in London, and 1*s.* 9*d.* here.

Mr. HUFFAM.—That must have been because your vessel did not remain in the docks long enough to be charged with rent. Vessels lay up at Hull all the winter in the docks, without paying any rent. In London, rent is charged at so much per ton per month, and I knew one vessel which paid 1100*l.* for rent. There are plenty of cranes; the largest at present is 20 tons; we have one making to carry 30 tons. They are at all times accessible upon notice, and for a fixed charge.

Ald. THOMPSON.—With respect to the conservancy of the port, it is difficult to get a local officer independent of the great local bodies, each of which possesses great influence; but I think there ought to be some government supervisor of the port. Before I conclude, I would wish to state that, in my opinion, most certainly a straight line of embankment ought to be carried out in front of the railway, and of the port altogether, so as both to secure a good scour and deep water, and also to restore to the town a site for ship-building, which the railway has taken away. As I said before, an iron vessel was recently built, and had to be carried across the rails before she could be launched.

COMMISSIONERS.—But did no one oppose the placing of this iron bar alongside the river?

Mr. HENWOOD.—I did as a director of the railway, but was overruled.

Ald. THOMPSON.—That is all very well, Mr. Henwood, but the directors of the railway were the directors of the dock company, and they did it to prevent any person from using the foreshore, and to drive them all into their docks.

Mr. HENWOOD.—I and Mr. Liddell did all we could to prevent it.

Mr. W. H. HUFFAM examined.—I have been secretary to the Hull Dock Company five years, and signed on their behalf two letters to the secretary of state in November last. I hand in copies of the Dock Acts and of the accounts of the company for the last four years (see p. .) The company are a corporation under the name or style of the Dock Company at Kingston-upon-Hull. The extent of the old dock (opened 1778) is 9A. 3R. 29P.; that of the Humber 7A. 24P. exclusive of the basin, which is about 2½A.; the Junction dock is 6A. 5P.; the area of the proposed Victoria dock is 12A. and 3514 square yards, and of its basin 2A. and 2416 yards; the Drypool basin is 1½A. and the railway dock 2½A., or rather more; water space in each case. Total, 23 acres of floating dock existing, and 15¼ in course of being made.

COMMISSIONERS.—Have the dock company received any complaints of the want of accommodation?

Mr. HUFFAM.—There have been complaints of the want of dock accommodation, prior to the company's going to parliament for powers to make the docks now in progress, and he understood there had been similar complaints prior to the construction of the Junction dock.

Mr. HENWOOD explained that when the Humber dock was made, it was done so, one half by the dock company, and the other half by the two other corporations, those of the town and of the Trinity House; and there was a clause in the Act for making that dock, that when the business of the port should require the Junction dock to be made, the dock company should bear one half of the expense. The dock company always understood that the Junction dock was to be made by the same parties as the Humber dock, but when they came to ask the other corporations to perform their parts, they refused, and it was found that, although the dock company was bound to bear half the expense, nobody was bound to pay the other half. The corporation do not receive dock dues, or any other benefit from the docks, only as the business of the port increases, their water bailiff's dues increase. And this increase they get without any expenditure.

Mr. HUFFAM.—The Victoria and railway docks are both making. The trade of the port was consulted in the planning of these docks. Mr. Hartley sat at the dock-office several days to receive suggestions, and then drew up that report. The great want was felt with respect to the timber trade, and that dock was planned to supply the accommodation required. There is a great deposit of mud in these docks. About 100,000 tons of this mud is yearly deposited by the company's barges in the Humber. I have heard complaints of its being emptied too near the town. There has

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not in my memory been any deposited in the river Hull. But there was once I believe a circumstance of that sort, when the harbour was so full of wind-bound vessels that the barges could not get out. I have heard complaints from the harbour master of obstructions to the navigation through banks and hills of mud in the river Hull. The dock company don't think themselves liable to prevent or remove these obstructions, or to deepen the channel. The western or railway dock will accommodate fourteen vessels. Upwards of 10,000 keels (I am informed by the dock-master) enter the Humber dock lock annually. There is no dock in the kingdom doing so much business. I can speak as to London and Liverpool. There is no lock in London through which anything near so many vessels pass. The dock company do not consider this an inquiry into their rights and property, and I appear more in defence of them than in any other capacity. I heard the statement of the president of the Chamber of Commerce, who said that the mud deposited in the Humber was the cause of the increase of shoals. I would observe that there are other causes of deposits—such as the shifting of sands. The president of the chamber stated that the accommodation of the railway dock will be insufficient for the trade, but I have to state that when dock accommodation was agitated, one dock was thought sufficient, and the dock company went to parliament for powers to make one dock only, but subsequently another was added. Mr. James Walker drew a plan four years ago, and his plan went to parliament, but the bill was lost. His plan was very similar to Mr. Hartley's. Mr. Rendel's plan was submitted by the harbour side proprietors. Mr. Hartley was subsequently employed by the dock company. He made the plans of both docks now in progress. The railway dock is expected to be opened in the month of May next; the other dock the contractors say they can do in two years and a half. I am not aware of any one having objected to the projection into the Humber at the east dock. Ald. Thompson is the only one who has objected, and as I have said before, the masonry is not going to be carried out so far as was intended.

Mr. Hassell.—Complaints of the insufficiency of the dock accommodation have existed from 1795. The town has been in communication with the dock company, and has appointed deputations from time to time to confer with them upon that subject. The dock company have never given accommodation until their docks were so crowded that vessels could not enter.

Mr. Henwood.—We had not a three-masted vessel in the port to open the Humber dock with.

Mr. Huffam.—Prior to any docks being made at Hull, the business of the port had increased so much as to render their establishment highly necessary. The making of them was offered to the corporation, and they declined; it was then offered to the Trinity House, and they likewise shrunk from the responsibility; the thing grew so bad that the bonding of the port was about to be removed to Gainsborough; then a body of merchant adventurers—(adventurers they were called)—undertook the work. The stock consisted of 120 original shares, upon which from time to time 250*l.* have been paid, and the last sale of one of these was registered at 1700*l.* The last 60 shares created were sold at 1300*l.* each. The whole of the shares are likely to increase in value. 40,000*l.* a year is now received, out of which a dividend of 60*l.* per share is paid, and the remainder of the net income is carried to the reserved fund applicable to new works. The old dock cost 64,000*l.*, the Humber dock 233,000*l.*, of which the company paid half, or 116,500*l.*; the Junction dock cost 160,000*l*, of which the company paid the whole. The company are making new gates to the Humber dock, and are widening the iron bridge from 13 feet to 24 or 25 feet, by the substitution of an entirely new bridge, which will be perfectly level, and turn upon a swivel. The pier-heads are likewise about to be thoroughly repaired. The depth of water at neap tides is 13 to 15 feet over the sill of the Junction dock; the springs rise 5 or 6 feet higher; the depth of the Humber dock at neap tides is 19 to 20 feet. The Junction dock sill was laid 5 feet higher than that of the Humber dock. Mr. Walker was the engineer. The old dock was first made, and the Humber dock next. The reason why the sill of the Junction dock was laid higher than the Humber dock was, that it was thought it would never be wanted excepting for light ships to pass through, or for ships to lie up in. It was necessary that the sill should be the same as either the Humber dock or the old, and it was made the same as the latter.

Mr. Hassell.—And the consequence has been the frequent detention of loaded vessels, and great expense in sending lighters to take out part of their cargoes.

Mr. Henwood.—The Junction dock was at first intended to be only a canal, but the plan was afterwards enlarged.

Mr. Huffam.—The Humber dock was made to admit a 50-gun ship of those days. There are not any steamers that I am aware of frequenting the port and unable to enter any of the docks. The large steamers have reduced the breadth of their paddle-wheels so as to pass the Humber dock lock, and they can all now come in. Another entrance to the Humber dock has been suggested, but when the east dock is opened, as well as the railway dock, I believe it will not be wanted. I believe there is no dock in the kingdom at which there is so much work done as at the Humber dock in this town. I have belonged to two of the London docks, and know that there is no dock there doing anything like so much work. The same is the case at the old dock. 700,000 tons of shipping annually visit the port. That is the amount upon which the dock company has received dues.

Commissioners.—Is there any arrangement for supplying the shipping in the docks with water?

Mr. Huffam.—The whole of the docks are to be supplied with water from the new water-works as soon as it can be laid on. The dock company made a suggestion that there should be stand pipes erected at suitable distances all round the docks, to which a hose may be attached, and vessels coming alongside may fill their casks in the hold.

The company have had prepared and have adopted a plan, for splaying off the entrance from the harbour to the old dock basin; the shipwrights' ways are to be removed for this purpose

Mr. Henwood.—The Drypool basin of the east dock will in like manner be splayed off.

The charges upon the improvement of the old dock were such as to absorb for three entire years the dividends, so that during that period they entirely ceased.

Mr. Hassell.—Because you made no reserve, but divided 90*l.* to 120*l.* a year upon shares of 250*l.* paid up.

Mr. Huffam.—The dredging of the docks is very systematically pursued; the depth of the docks was maintained; the chief deposits of mud were in the Humber dock and the old dock; and the Junction dock, which is a still water dock, was dredged for the first time last year (16 years after

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the opening), and less than eight inches of deposit was found therein; the depth of the docks is reported every quarter; the company has one steam dredger, of which they have this year increased the power to 26 horses;—this dredger lifts 15 barge loads of 50 tons a piece per day, and the barges are towed out by a steam tug, which takes them as far as the mid stream of the Humber; if it blows fresh, they sometimes cannot get out so far as they ought to do, but notice is taken of this circumstance, and the men have been fined for not taking the barges out far enough, and for depositing the mud too near the shore. Several gentlemen have offered opinions that the sluicing out of the mud from the Humber dock basin leaves a portion of the mud in the Humber, near the outer entrance of the basin, thus decreasing the depth of water at that important point, but the fact is that all along in front of the port of Hull at that part there is no mud at all: it is all brick-bats, crockery, shingle, &c. It is all a hard cranch, so that the sluicing does not affect the deposit at all. The crockery and brick-bats come from the manufactories. The dock company has no power to stop such nuisances.

Mr. HASSELL.—In 1813 or 1814, Messrs. Burstall had a vessel (the *Henry*), which broke her back upon the bank of mud in the Humber dock basin.

Mr. HASSELL next enquired of Mr. HUFFAM, whether he was not aware that the bank in the Humber dock basin was at present in a dangerous state, and that only a day or two ago, a ship called the *John Jardine* was damaged by getting upon it. The *Llan Rumney* had also been seriously damaged on the same bank.

Mr. HUFFAM.—This bank is dug away, at considerable expense, by the dock company, twice a year.

Mr. HASSELL.—Has not an old ship of war been so placed as to aid the scour through the basin?

Mr. HUFFAM.—This vessel was purchased for the purpose of being placed in such a situation as to increase the scour, and has been placed in the best situation known, and the effect is the channel of the basin is wider than before. The Humber is a very muddy river, and has a very great tendency to warp up this basin. We have lately altered the piers which Mr. Rennie made. They are now open, and the form has been altered to the best known for the convenience of ships entering and departing. We have not found any minute in the records of the dock company of the line of low-water mark being fixed by Grundy and another. It is the duty of the harbour side proprietors to scour the haven. They have had their compensation in the privilege of erecting quays and wharfs in the river, and of bonding sufferance goods.

Mr. HASSELL.—That is a disputed point. Mr. Philip Green, who had a ship damaged by one of the hills in the river, took it to trial.

Mr. HALL.—The *Emperor*, I remember, was greatly damaged by resting upon one of them. She was a large ship.

Mr. HUFFAM observed that the company had consented to the abolition of the dues upon a numerous class of vessels—the river craft—using the old harbour, and that the company's loss under this clause of their last Act amounted last year to 2000*l*.

Mr. HENWOOD asserted that, notwithstanding all that had been said against the dock company, their great object had been to increase the facilities for shipping, and raise the character of the port.

Mr. SMITH, the chairman of the committee of owners of property on the harbour, handed in a copy of a memorial of the harbour side proprietors to the corporation of the town; also the four reports of the committee of owners of property on the harbour side; with copies of evidence in the House of Commons on the Hull Dock Bills of 1825, 1841, and 1844, and called the attention of the Commissioners to the evidence respecting the state of the harbour given by Mr. Gibson, Mr. Ward, Mr. J. Walker, and Mr. S. Walton; to Thos. Lundie's, Capt. Agars', Capt Langland's, Capt. Waterland's, and Capt. Oswald's, on the state of the Humber, and to Mr Rendel's on both subjects. Also to certain memorials in the evidence of 1841, from the committee of owners of property, on the affairs of the dock company.

There was likewise handed in a copy, published in the *Eastern Counties Herald* of the 22nd August, 1844, of the payments out of the Consolidated Fund for vessels under the Reciprocity Treaties (see p.)

Mr. HASSELL.—The dock company are making the docks, but the time may come when further dock accommodation may be needed, and it is desirable that, when that time shall arrive, there may be as perfect an understanding on the subject as possible. During the last twenty years upwards of 50,000*l*. have been spent by parties in the town in contesting the dock company's bills in parliament. Parties enter warmly into these contests, and feelings get in which are very injurious to the trade of the port and private friendships. Besides, whenever a bill is brought into parliament for the making of new docks, further rates and privileges to the company are asked for.

Mr. JOHN HALL, one of the Elder Brethren of the Trinity House, examined.—When I first went to sea, about the year 1795 or 1796,—50 years ago, I found the charts of the Humber very defective, and also the buoyage and beaconage. It caused me to set about publishing a better chart. I had not an opportunity of surveying the Humber till the year 1822, when I made a complete survey. I have examined it frequently since. There is a good deal of alteration in the sands and shoals since my first survey. Referring to the chart of the Humber, Spurn Point has very much washed away since I can remember. I am aware that shingle is being carried away daily from Spurn Point to a great amount.

COMMISSIONERS.—Is it likely in any degree to risk the stability of the lighthouse?

Mr. HALL.—I think not materially. The land is much altered in form. There is deep water in the Humber near its point. The Inner and Outer Binks are also much altered. They used to be dry some years ago at low water, but now the Outer Binks are nearly scoured away. The channel between the Inner Binks and the Spurn was closed up, but I believe it is opening out again. I once spoke to the late collector of Customs at this port, who was the agent to the proprietors of the light, upon the peril of the outer lighthouse, or lower light, at Spurn, after a storm had taken away a great part of the main land. I recommended that a jetty should be thrown out at the north end of the island, by which means I fancied we could have saved the low lighthouse; but nothing was done, and now the lighthouse is swept away; the present low light is merely a temporary one. On the Chequered Shoal there is no material alteration. There are sixteen or seventeen feet water upon it

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at low water. The Bull Sand I remember having only four feet upon it in 1822; it afterwards had three to four fathoms upon it, but it has laid up of late.

Mr. BEE.—There are only about eight feet sometimes at low water.

Mr HALL.—It appears there is a further alteration since I last surveyed it. The tail end of the Lower Middle Sand has extended very considerably to the south-east, towards Spurn. This part has not more than two and a half fathoms at low water upon it. The upper part of it is a good deal scoured away, and also about the middle. Clee-ness continues much the same. It is composed of stones and shingle. Grimsby Inner Roads are very shallow, and there is not much alteration in them. They have remained much the same from the time of my first survey. Stallingborough Flats are nearly the same. The Sunk Spit is also pretty nearly the same. The Holme Sand has extended a little down towards Sunk Island; it has warped up in places, and a buoy was placed there a few years ago. Skitter Sand is much the same. Opposite Hull, the Middle Sand has, since 1822, extended very much down the river eastward. I remember the first time the steam boat from Barton to Hull arrived at low water, the leading mark to clear the sand end was Queen-street open; now vessels are obliged to go considerably below the garrison to clear it before they can reach Hull. There are four feet water upon it at low water. Some time ago I saw this Middle Sand abreast of Hull dry, at which I was very much surprised. It is now scoured away again. The breadth of the river is about 1½ miles. The Middle Sand is calculated to increase. I fear that it is partly owing to the mud barges being emptied into the river. There are twelve to fifteen boats discharged upon it almost daily, or about 100,000 tons a year.

Mr. MANOER.—If you were only to see what a large proportion of this immediately enters the harbour, you would be surprised.

Mr. HALL.—The best anchorage is abreast of the citadel. There is no foul ground opposite the port, nor till you come to the Hebbles. It is about one nautical mile from the Hebbles to the entrance of the now making east dock. The anchorage above Hull is not so good for vessels of great draught. I think it very desirable that the deposit of mud in the Humber should be avoided. I once drew a plan to avoid to a considerable extent the necessity for the dredging machine in the proposed new docks, by preventing to a great amount the deposit of mud in them. My plan was to have bonding ponds for timber, through which the muddy waters of the Humber should pass and make their deposit. I would have fed the new docks with pure water. The expense would not have been very considerable.

COMMISSIONERS.—If the Middle sand continue to extend downwards, will it not destroy the port?

Mr. HALL.—It will for large vessels of deep draught of water; nor is there any expense too great to be incurred in the averting of so serious a calamity. The channel of the old harbour runs out in a south-west direction, and it will continue to do so, but it would be easy to form another channel at the entrance through the bank of mud, and to direct a scour of the harbour water through it, and so carry away the bank in a south-easterly direction.

COMMISSIONERS.—Would it not be an advantage to the navigation, and so take the course of the Humber tide?

Mr. HALL.—It would be an advantage to make the water from the harbour turn to the south-east, but the strength of the current in its present direction is great, and I question whether it can easily be diverted. The cranch in front of the entrance is increasing from the rubbish thrown overboard into the harbour and river above the bridge. The dock company and the corporation agreed on one occasion to remove the cranch, and it would be well if they would agree to remove it constantly. I have been applied to as a member of the Trinity Board to remove the obstructions in the harbour, but we have not done so because this duty lays with the corporation. As owners of the soil they are responsible. I have seen large quantities of rubbish thrown overboard from the carpenters' yards. After repairing a ship, they have taken all the chips and rubbish out of their dry docks and thrown them into the river. I have also been told of the same being done at other yards above the bridge. And that such had been the case was very evident when they came to remove the cranch, from the extremely large quantities of pitch and tar, and chips, and other stuff taken from ship-yards, found there, which had conglomerated into so solid a mass that very great difficulty was experienced in getting it up. There are many banks and mud bills in the harbour which did not formerly exist there.

Mr. JAMES OLDHAM, C.E., handed in a copy of the survey and report which he had prepared at the request of the corporation of the Trinity House, on the state of the obstructions to the navigation in the old harbour. He observed that he had not made a comparison between the present and past state of the river, but merely a statement of the hills, banks, &c. Some of those banks he considered sufficient to break the back of a ship. The report was as follows:—

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Oldham's Report on the Old Harbour.

No. 217.

Report of J. OLDHAM, Esq., C.E., *on the state of the Old Harbour at Hull.*

"GENTLEMEN,

"*Hull*, 28*th March*, 1844.

"Having received your instructions to make an inspection of the old harbour, or that part of the river Hull between the North bridge and its outfall into the Humber, and to report upon its present condition as a haven or harbour for ships and other vessels, I beg to submit the following statement:—

"This portion of the river Hull is used by vessels of various tonnage for taking in and discharging their cargoes along the quays of the warehouses, timber-yards, &c., on both its banks; as a passage for vessels going into and coming out of the old dock, and also for vessels proceeding to the various yards and warehouses above the North bridge, as well as to Beverley, Leven, Driffield, &c., &c. It is also used by river craft, and other small vessels, as a place of shelter in stormy and tempestuous weather, when it is frequently crowded for many days together.

"The trade carried on by water communication in the old harbour is very considerable, and before the first dock was constructed it was the port for the whole of the shipping trading to Hull.

"The length of this portion of the river is from ten to twelve hundred yards, and varying in width from fifty to eighty yards. The river Hull is a tidal river, with a flow or rise at ordinary spring

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tides of 18 or 19 feet, but at low water there is a comparatively narrow stream or channel, averaging about one-third of the harbour in width, and formed rather nearer to the eastern than to the western side.

"The bed of the old harbour is in a very bad state at the present time, from the accumulation of immense mud banks, some of which form abrupt mounds or hillocks, with not more than from 10 to 15 feet water over the tops of them at ordinary spring tides, while in their immediate vicinity, and within a few feet of them, there are deep channels or hollows, the bottoms of which in some places are as much as from six to eight feet below the tops of these elevations. These mounds jut out from 12 to 20 yards from the quays.

"It will be seen by the soundings I have taken that there are variations in the bed of the harbour, amounting in some places to 17 feet. These mud banks and depressions are the most numerous and of the worst description between Conduit-street and the junction with the Humber, thereby rendering the entrance for ships both dangerous and difficult. One of these banks, which is a considerable barrier to the harbour, commences about the inner end of the long garrison jetty, and extends in about a south-westerly direction to low water mark in the Humber. The direct entrance to the harbour is quite obstructed, and the channel thrown so far to the west as to give a sort of tortuous or zigzag line to the channel, and thereby rendering the movement of ships in and out very difficult and hazardous. Some parts of this bank are from 16 to 20 feet above the sill of the lock of the Humber dock, and the magnitude of the banks is very much on the increase, on account of the projections into the Humber, west of the harbour, which have in late years been made.

"There are several ship-yards along the banks of the old harbour, and in the front of some of these are what are termed 'ways,' being level platforms for the purpose of laying ships upon, when temporary or slight repairs are required to be done to them. These 'ways' are formed of concrete, and are therefore hard, firm, and compact. Their surface is about from 7 to 10 feet above the channel of the river, and generally present an abrupt bank close to it; they are extremely dangerous formations in a tidal harbour, and ought not to exist. It has been and still is a custom for persons occupying wharfs and warehouses, both above and below the North bridge, to construct in the front of such wharfs and warehouses, embankments of stone work to form what they call 'docks,' being berths for vessels to lay upon or in, when discharging or taking in cargoes. They are made by forming a bank of stones along the edge or margin of the stream or channel at low water, and then a bed is formed from that point to the quay or wharf wall. Many are from 10 to 12 yards in width. A great number of these exist, several of which I have seen constructed; they are exceedingly dangerous and obstructive to the navigation of the river, and offer a serious impediment to the trade upon it. On account of the great quantity of rough masses of chalk and other rough stones being placed in the bed of the river for the formation of these docks, as well as immense quantities of rubbish of every description being discharged into the river, there is constant danger to the shipping using the harbour. These stones and rubbish are being continually carried down the channel of the river, where vessels cannot avoid grounding upon them, and no doubt to their injury and, it may be, destruction.

"The stones and rubbish thus cast into the river will in a great measure account for the formation of the bar, or what is here called the 'Cranch,' formed between the mouth of the old harbour and the Humber dock basin, so often and so justly complained of as an impediment to ships entering and leaving the port.

"Taking into account therefore the number and size of the mud banks along the whole extent of the old harbour (only some of which have been particularised), the ships' 'ways,' constructed of hard, compact, and unyielding substances, the immense quantity of stones and other hard matter thrown into the river, to say nothing of stumps of piles and other impediments, I am of opinion that the old harbour is in an extremely dangerous state for the purposes of navigation and the safe mooring and laying of ships, and except a remedy be speedily provided and measures taken to check and remove these growing evils, it will become in a short time totally unfit for ships to enter and lay in.

"The following is a statement of the soundings I have taken, showing the comparative heights of the bed of the old harbour above the channel at different points between the North bridge and its outfall into the Humber. These soundings were taken on Saturday last, the 23rd March, at high water.

	Soundings.		
	Banks, &c.	Channel of river.	Difference.
	Feet.	Feet.	Feet.
Ship-yard adjoining the North bridge, occupied by Messrs. Humphrey. Ship ways	10½	20	9½
Ship-yard south of the Old Dock Basin. Ships' ways	11	18	7
Ships' berth in front of the warehouse immediately south of the last-named ways, and within a few yards	18	..	7
Front of Messrs. Harrison's office. Ships' berth	15	20½	5½
Opposite St. Peter's-street wharf. Bank on the west side	13½	20	6½
Conduit street. Piles, &c., at the outfall of the Citadel sluice	11	22	11
Front of Holden and Sampson's wharf. Mound front of the wharf	14	22	8
Ships' berth immediately to the south of this mound	20	..	6
The difference between the two last soundings about 20 yards.			
Between Brownlow and Pearson's wharf and Bolton-street. Mound in front of Brownlow and Pearson's wharf	14	23	9
Ships' berth south of the mound last-named. Mound	14	20	6
Bolton-street wharf. Along the front of the wharf	6	23	17
South side of Blackfriargate staith. Near the staith	9	25	16
Opposite to the corporation's wharf, where the Old Chain House formerly stood. Near the crane	9	24	16
Outer dolphin at the entrance of the river. Close to the dolphin	8	25	17

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"At the time the above soundings were taken, there was a height of 24½ feet water on the sill of the gates of the Humber dock lock; therefore the height of the mud bank at the outer dolphin is 16½ feet above the sill of the lock. The height of the tide that morning may be considered about the average flow of ordinary spring tides.

"By the last remark it will be seen, that at the very best tides it would be quite impossible for many of the ships which enter the old harbour to pass over the summits of some of the elevations of its bed, and were a ship to ground on some of these she might be greatly damaged, if not entirely destroyed.

"In conclusion, I beg to remark that in consequence of the tortuous direction of the channel, the undulating state of the bed, and the immense accretions of stones and rubbish, I consider the old harbour exceedingly dangerous for the purposes of navigation.

"I am, &c.,

"JAMES OLDHAM, C.E."

"*To the Wardens, Elder Brethren, and Assistants of the Trinity House, Hull.*

Evidence taken on the 22nd Oct., 1845.

Mr. **OLDHAM**, examined.—The river ought to be kept in an efficient state for navigation, and might be by giving a free open course to the current, and by the use of the dredging machine. The tide flows 15 miles above Hull. If all the obstacles were removed, the arches of the North bridge opened out, the ways removed, and the casting into the river of rubbish, &c, prevented, the tide itself would scour this river. But to effect this it is absolutely necessary that such practices as these should be prevented, namely, the making for ships of docks or berths in the river, the casting into the river of refuse of ship-yards, factories, lead works, &c. One of the banks thus created is formed at an angle of repose from the top of the wharfs to the bottom of the river. This is above the bridge, and I mention it, although beyond the extent of my soundings, because there cannot be a doubt that great quantities of the rubbish thus thrown into the river are brought down by the current, and assist in forming hills and banks, both at the harbour and at its entrance. I had no authority to sound above the bridge.

Mr. **JOHN SMITH**.—I knew one vessel which was lost in the Humber some years ago. In consequence of lying, when loaded, upon one of the hills in the harbour, she sprung a plank; the mischief was discovered when she was out in the Humber—one man lost his life, and another had to swim for it. The dock company receives dock dues, and the corporation receives water-bailiff's dues, from vessels using the old harbour. In my opinion these parties ought to keep the harbour in an efficient state for navigation.

COMMISSIONERS.—Do you think that the river face of the town in its present form is the best for navigation?

Mr. **OLDHAM**.—Certainly not. I think that if it were of one uniform line, the navigation would be improved; that, in fact, the depth of water close up to the port, and the general facilities of shipping, would be increased. If we had a resident engineer for 40 years, whose duty it should have been to have attended to the efficient state of the navigation, and to prevent the construction of all manner of works which would injure the same, I have not the slightest doubt the navigation would have been much better and safer than it is. The traffic of the port would warrant such an outlay as would be incurred in his support. I believe the docks and gates are in good repair. The eastern dock projections into the Humber will cause deposits of warp on each side, and will undoubtedly to some extent alter the course of the current. The railway has been formed close to the shore. I thought that a very great objection, as it destroys the river frontage of the port, which was especially valuable for ship-building and for quayage, and would have greatly increased in value, and have been of incalculable facility to the business of the port. Besides which, it was destroying that which they could not by possibility restore.

COMMISSIONERS.—You are aware that the railway company are at this moment carrying out an embankment, and restoring thereby to some extent the even frontage of the port.

Mr. **OLDHAM**.—I am aware of it. But I am sorry that they have not gone much further out.

COMMISSIONERS.—Yes, that is another error which they have committed, and proves the same thing,—the want of some competent authority to decide upon the nature of new works affecting the navigation.

Mr **OLDHAM**.—It is all very well what they are doing, so far as it goes, but there should be some general plan for the whole river frontage of the port, as affecting all parties whatever, and which should be imperatively adhered to. Several plans were proposed for the outer line of the new works: the one by myself was to extend from above the extremity of the corporation's jetty in a direct line to the outer end of the wharfs of Messrs. Earle's cement works, but Mr. Walker having a view to the probability of a dock being constructed in this situation, thought proper to adopt and recommend to the Admiralty the line now being carried out—his object being to save expense hereafter of excavations in the formation of that dock. It ought to have been made in a line with the outer works of the Humber dock, and then it would have formed one general line with the outer works of the Victoria dock, east of the citadel. But now the opportunity is lost, and may not be recovered for years.

Mr **SMITH**.—Have not the corporation encroached upon the harbour in the construction of their new graving dock?

Mr. **OLDHAM**.—They have cut off part of a corner of the river, but I do not consider that an obstruction; on the contrary, by straightening the course of the stream, it aids the scour. [Mr. O. pointed out the spot upon the map where the corporation had recently made this alteration. He then sketched upon the map the form which he thought the best for the entrance of the harbour.] The sooner the outlet to the eastward is made, the better for the navigation. I am satisfied that we shall never have the best navigation until a straight line of foreshore to the Humber is restored.

Mr. **HASSELL**.—Do you know where the old line of the foreshore formerly existed?

Mr. **OLDHAM**.—When the workmen were digging for the foundation of the Victoria Rooms in Queen-street, and at the north-east corner of that street and Humber-street, I was passing, and saw that they had exposed to view an ancient jetty. I took a sketch of it, which I could procure for the Commissioners, and would have brought it had I thought this question would have been asked. But it is positive proof that the foreshore of the town was once there, and Mr. Thompson has said here to-day that he landed there from a boat 50 years ago.

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Mr. **HALL**.—The deep water channels of the Humber continue much about the same as they were some years ago. In some parts the sands have scoured away, and in others they have laid up. Generally speaking, the soundings are nearly about the same as they were years ago. Copies of the report of the survey of Mr. Oldham, C.E., were sent to the corporation of the town.

The lighthouses at Spurn now belong to the Trinity House of London. But all lights in the Humber above are local. They are found to be sufficient, for the steamers pass up and down at all hours of day and night. I know the river Thames, but am not well acquainted with it; formerly I think it was not nearly so well lighted as the Humber. The local lights in the Humber are, a floating light upon the Bull Sand, two lighthouses at Killingholme, another floating light on the Hebbles, a lighthouse at Paull, and a beacon light at the Pilot-Office. The buoys are very conspicuous.

The floating light off Spurn is a guide as to the Inner and the Outer Binks, and vessels entering the Humber.

While on the subject of a harbour of refuge, I beg to observe that the Humber is accessible night and day, at all states of the tide and in all winds and weathers. Hawk Roads afford safe and sure anchorage. Grimsby Outer Roads are safe, and also the Sunk Roads, White Booth, and Paull Roads. The port of Hull is a port of refuge. And there is one place to which I wish to draw particular attention, as it possesses deep water, and would at all times be accessible to vessels seeking refuge. It extends about one mile below the low light of Killingholme, and is not two miles from the Grimsby railroad. I name it particularly as the most favourable spot in the Humber for a dock, if the government should think of forming in the estuary a naval depôt or dock yard. There is deep water there along the shore. The deep water channels of the Humber take a serpentine course. That course is often a considerable distance from the shore, but when you have it close to the land it is a great advantage to shipping. Now that course comes close up to Killingholme Creek, where there is deep water, and from thence it runs nearly south-east to Spurn, and out to sea. The depth of water upon Stallingborough Flats has varied very little since I knew them. As to Grimsby Roads, there is no chance whatever of there being any increase of water with reference to the inner roads, because the tides have no power to scour away the mud, and can obtain none on account of the hardness of the shallows, both on Stallingborough Flats and Clee-ness. And for the same reason it is not possible, in my opinion, to get deeper water at Grimsby, which lies between them, whereas the place I have already drawn your attention to is but seven miles higher up the river, and may be reached in half an hour's sailing.

If art had assisted nature, as it might have done, Hull would have been at this moment a far superior port to what it is.

The fact is, that for the natural facilities in coming up to Hull from Spurn, I do not at this moment remember a parallel. Liverpool is nothing to be compared to it.

I don't know a worse "loose" than Liverpool. I was always fearful of my vessels leaving Liverpool in certain states of the wind. And yet Liverpool has risen to be one of the first ports in the world in spite of the Mersey and its dangers; had the natural advantages of Hull been seconded by a becoming spirit, its trade might have been vastly increased.

COMMISSIONERS.—Four years ago I was surveying for the Admiralty in the Humber, and I have great pleasure in stating here what I then officially reported to the Admiralty, and which is now confirmed by another visit and closer examination, namely, that not only is the Humber one of the finest rivers in the kingdom, but that I have never seen a river better lighted and buoyed than the river Humber. That all this should be done by a local board is highly creditable to that board.

Mr. **HASSELL**.—The Trinity House receives nothing for the lighting of the Humber, which they pay out of the buoyage, and there is not a tittle of allowance or tax for the lights. I have seen a copy of the report to the Trinity House as to the line of low water mark, which was directed under the Humber Dock Act to be ascertained for fixing the extent of the dock company's outer works, and which I believe the Trinity House can furnish the Commissioners with.

As a proof of the growth of the mud bank at the citadel corner of the harbour, I may state that the inner dolphin of the two, which the Commissioners saw and have marked upon plans before them, was in the memory of most of us the only dolphin, and that the second, which is of recent erection, is now almost as much surrounded with the mud bank as the inner one was when the outer was erected. I may also state that a legal opinion has been taken from the Recorder, and handed to the corporation, expressive of their responsibility as owners of the soil to cleanse the harbour (see p.). Within my knowledge the traffic of Hull has increased very considerably, so much so that the harbour, which formerly was, with the then existing dock accommodation, sufficient for the port, became so crowded with shipping, that I have heard of one vessel leaving South-end and arriving at Elsinore, before another just behind her could get out of the harbour. [Another gentlemen present stated that he knew a third make the passage from Hull to Petersburg, while a fourth, ready for sea at the same moment, was proceeding down the harbour from the old dock to the Humber. Several gentlemen confirmed this statement.]

Mr. **BENJAMIN BEE** (buoy-master to the Trinity House.)—Fourteen years ago I suffered that detention.

COMMISSIONERS.—And which might have been avoided by a proper spirit of enterprize on the part of those, at this port, whose duty it was to provide shipping accommodation. Can you speak as to any alteration in the sand or other banks in the river?

Mr. **BEE**.—There has been considerable shifting during the last four years, and a great accumulation upon the Bull. There are 54 buoys in the Humber, all under my management. They are very good and conspicuous; the same as you saw four years ago. I have occasion often to sound, and I find that the Middle Sand has a great tendency to creep down towards the mouth of the Humber; it has so increased three-quarters of a mile in my time, and has extended into the channel. If it extend much further, it will tend to stop up the trade of the docks at Hull. Something should be done to prevent so serious a circumstance taking place. There are 150,000 tons of mud annually emptied out of the dock company's barges upon or close to it. That ought not to be allowed, and at whatever expense, it would be very desirable to convey the mud to some other place, and not to empty into the river at all.

COMMISSIONERS.—The growing up of that Middle Sand would be fatal to the port of Hull.

Mr. **BEE**.—The Humber is a harbour of refuge at all times, and in all weathers, and that being the case, every effort should be made to preserve a good passage to the port of Hull, and to give that

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accommodation to shipping which its highly favourable natural advantages and great traffic demand. I do not think that there is that accommodation in the docks which the trade of the port requires. I do not know of anything more that can be done to render greater accommodation to shipping, as to buoyage, beaconage, and lights. There are transporting buoys in the Humber, but they are seldom used since the steam tugs came into use.

Mr. HALL.—Barometers are kept at the Pilot Office, at Spurn, and at the Bull. Believes a registry is kept at the Pilot-Office, but cannot speak positively.

Mr. BEE.—The Bull Sand floating-light vessel frequently breaks adrift. She is moored to a mushroom. The cause of her breaking adrift is the water being too shallow, and it generally occurs under a W. N. W. wind, bringing a fresh down the river. The light vessel at Spurn has never broken adrift. I consider the Bull Sand float is in the best place that can be given to it.

Mr. JAMES SPRATT, Chairman of the Commissioners of Humber Pilotage, stated.—There are 48 Humber pilots, 6 boats, 6 masters, and 2 apprentices in each boat, in addition to the pilots. The pilots are made and broken by the Trinity House. In all other matters they are under the controul of the commissioners. There are always three boats below and three up. The commissioners are composed of 40 merchants, with the mayor and 12 other representatives of the corporation, and the whole of the Trinity House. Their governing act of parliament was passed in 1832. If any vessel comes within the limits of the pilotage without displaying the signal for a pilot, she is liable to a penalty. The signal is a flag by day, and a light by night. In case of the signal being omitted, the case is investigated by the commissioners, and if they see reason to believe that it has been done intentionally to reduce the amount of pilotage, the commissioners direct the case to be taken before the magistrates, who have the power to impose the penalty, and as no case is taken which has not thus been previously considered, the offenders are usually fined. The pilots are paid by their earnings and not by salaries. They wear no badges—to which they have an aversion—but carry their licences with them.

THOMAS LUNDIE, one of the oldest pilots in the port, stated that he was well acquainted with the anchorage of the Humber; that the whole of the Hull roads are perfectly safe, excepting when a ship rides too near the Hebbles. I have known two in my time be completely wrecked nearly opposite the garrison. When there were no steam-tugs it was necessary for vessels to bring up below the port, and it was in consequence of their so doing, and afterwards swinging round upon the Hebbles, that the damage occurred. The west-end of the Hebbles, which is composed of very large stones, is about a quarter of a mile from the entrance of the east dock. The Hebbles are large stones, dry at spring tides, with eight or nine fathoms close to them. My opinion is that the east dock is not in the best place, but that the harbour should have been converted into a dock, according to Mr. Rendel's plan. I have seen the Middle Sand lower than it is, and I have seen it much higher. Some people say that the scouring of the Humber dock basin does not affect the shoals before the port, but I say that it does, leaving its deposit between the entrance of the Humber dock basin and the old harbour; and to such an amount is this taking place, where the two streams leave it opposite the Pilot-Office, that I give it only five months to dry up. The new dry dock of the corporation has not encroached upon the harbour. The mooring post at the corner close to the harbour remains in the same spot where it was, and has not been removed.

Mr. HASSELL.—Mr. Laverack complains that the river is much narrower at this point than it was, which is owing to the deposit of mud at the dolphin.

WILLIAM MANGER, harbour-master, stated—When I first went to the harbour in my present capacity, I found great difficulty in laying vessels safe, greatly in consequence of the bank laid by the old ferrymen, who bring stones and various kinds of hard materials to lay them upon the bed of the river, to form paths to their boats at low water. I put a stop to it at last. Mr. Laverack and two or three other proprietors of property along the harbour complained to me, and requested I would see to it. I wrote a letter in 1841 to the Trinity House (who appointed me to the office of harbour master) upon this subject; I sent another letter to them in 1842, and in course of time I sent four letters, one every year, stating that something ought to be done to remove the banks and hills from the harbour. Still nothing was done until just now, when some notice appears to be taken of the matter. I believe the cause of these banks arising is vessels always lying in one position (such as the traders, of one size, and regularly using one wharf), so that the mud banks arise at each end of the vessel, until ultimately the same ships cannot get into the very berths which they have made. I think the river might be dredged to great advantage. That same projection of which I have spoken, the ferry boatmen's landing in the harbour, acts as a dam to the waters of the river Hull, and that to so great an extent that, at half tide, there is no force at all to aid in carrying that bank away. The channel has become so narrow as scarcely to be sufficient for one ship. In consequence of these banks I find great difficulty in taking vessels through the harbour to the old dock. On the east side of the river, and in its bed, there are ridges of stones laid and formed into docks for the use of the vessels using particular wharfs.—In answer to various questions by the Commissioners, this witness stated his belief that the docks he had named were of considerable service to particular parties, but that it would be a great improvement to the navigation to have them all removed; that the witness had had some experience of other ports, but that he never knew one in a more neglected state than the old harbour at Hull.

Mr. DALE BROWN.—I have known 43 sail of vessels in two hours and twenty minutes require to pass through the harbour, which is the highway to the old dock, and in 1844, 46 sea-going vessels and steamers, 28 river craft, and 1 large raft of timber, passed through the Humber Dock lock in one tide.

Mr. MANGER.—I have known one hundred sail of vessels come out of the old dock in one tide, and that being the case, it is my opinion that the navigation is not conserved as it ought to be, and most certainly I think that some controlling power is wanted at Hull with respect to its navigation.

I know of ballast being thrown overboard, and of chips and refuse from the ship-yards; of the casting into the river of oyster shells at Blackfriargate end, and other acts similar to those stated by Mr. Oldham; and the deposit of mud in the mid-stream of the Humber is calculated to injure both bat river and the old harbour.

Ald. THOMPSON offered to bring evidence that the dock company's mud barges had begun to deposit within 100 yards of the harbour mouth.

Mr. MANGER said he knew such a case which had recently occurred.

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Mr. DALE BROWN said, a few months ago, he was desired by the chairman of the dock company to watch the bargemen; he did so, but never saw them go half across the mid-stream of the Humber; he frequently saw them empty the barges within 160 yards of the west pier. The Middle Sand was two feet above the water not a long while ago. He added—I think there is no doubt that the increase of the sand is owing in part to this. I gave information of the conduct of the bargemen to the secretary of the dock company, who afterwards told me they had been fined.

Mr. JOHN SMITH volunteered some remarks illustrative of the same point, which Mr. Lundie corrobated.

Ald. THOMPSON said the men had their fifteen barges to bring out of the docks and back, and were so anxious to return to the docks the same tide, so as to avoid the unpleasantness of penning or having to wait until the next tide to get back into the docks, that they were always in such a hurry that they had not time to wait until the tide turned, but often emptied their boats before the top of high water, which allowed the mud either to float up the river or into the docks, or to deposit where it was. In his opinion the best way would be to empty the barges in the ebb tide, if emptied they must be into the water at all.

The COMMISSIONERS said their own opinion was, that it would be better even to carry it away by railway than risk the bare possibility of destroying their port for the sake of sparing a little expense. And they trusted that the full information given upon so important a point, together with the concurrent opinions of every sailor connected with the port, of the dangers which have arisen from this practice, would receive from the Dock Company the immediate attention it demanded.

No. 217 *a*.

Return of British and Foreign Tonnage for Dock Dues.

No. 217 *a*. Dock Dues and Port Charges.

Dock Office, Hull, Nov. 15th, 1845.

1826	355,698	1836	503,465
1827	424,230	1837	535,022
1828	368,562	1838	594,823
1829	365,962	1839	702,584
1830	859,942	1840	652,508
1831	404,429	1841	660,673
1832	340,339	1842	595,505
1833	354,237	1843	653,309
1834	392,548	1844	762,424
1835	413,135		

HULL PORT CHARGES ON SHIPPING AND GOODS.

	£.	s.	d.	£.	s.	d.
ON SHIPPING.— Hull Corporation, 1844-5—Ferry Dock, for sea-going vessels, 2*l.* 5*s.*; North Bridge Dues, 286*l.* 14*s.* 10*d.*; Jettage, 1,349*l.* 15*s.* 10*d.*; Anchorage, 414*l.* 7*s.* 5*d.*; Hostage, 60*l.* 17*s.* 4*d.*; Ballast, 2*l.* 13*s.* 4*d.*				2,116	13	9
Trinity House, 1844-5.—Buoyage				3,820	8	2
Dock Company, 1844.—Dock Dues				38,934	4	4
				£44,871	6	3
ON GOODS.—Same years.—Hull corporation.—Water Bailiff dues	2,846	6	1			
Trinity House.—Primage	9,297	7	5			
Do. Fines of Aliens, on importing and exporting cargoes	4,310	10	8			
Dock Company.—Inward wharfage, labourage, and warehouse rent.	12,044	16	9			
Do. Outward wharfage, under 198 sec. 8 Vic. 1844, limited to 6,500*l.* additional				28,499	0	11
ON GOODS AND SHIPPING.—Hull corporation.—Reciprocity returns				2,137	6	1
				£75,507	13	8

No. 217 *b*.

No. 217 *b*. Number of Tons of Mud raised, 1839–44.

HUMBER MUD.

Return of the tons of mud raised, in the respective years, from the Old Dock, the Humber Dock, and the Humber Dock Basin, with the exception of 1843, which includes 6,463 tons raised from the Junction Dock, which was dredged in that year and in no other.

1839	109,088	1841	115,191	1843	83,522
1840	84,905	1842	109,069	1844	98,652

Dock Office, Hull, Dec. 2nd, 1845.

W. H. HUFFAM.

No. 218.

"ACCOUNT of the RECEIPTS and EXPENDITURE of the DOCK COMPANY at KINGSTON-UPON-HULL for Duties on Shipping, Wharfage, Rates on Goods, &c., at the Port of Hull," for the Years ending December 31st, 1841, 1842, 1843, and 1844.

Dr.	1841			1842			1843			1844		
	£.	s.	d.	£.	s.	d.	£.	s.	d.	£.	s.	d.
The respective years commenced with balances in hand of	24,764	9	11	32,325	6	3	19,603	11	11	19,445	3	10
The Dock Duties received (including reciprocity returns) were	32,286	16	2	29,081	16	9	30,115	8	1	38,934	16	9
The "wharfage, labourage, and warehouse rent," together amounted to	11,781	0	7	10,469	9	8	9,660	16	8	12,044	16	9
Rents of premises	3,288	15	11	3,287	18	8	2,817	5	0	2,902	19	10
Interest at the bank	606	6	11	282	5	1	264	0	9	293	10	5
Other items made, with the above total receipts of	48,685	10	2	43,430	11	0	43,493	13	6	54,551	61	3
The income, including balances in hand, was	73,450	0	1	75,755	17	3	63,096	5	5	75,449	18	11*

* The last-named sum (75,449*l.* 18*s.* 11*d.*) includes 1,452*l.* 18*s.* 10*d.* transferred from the Company's "Current account" of the preceding year to the "Construction account" of the Victoria and East Docks.

EXPENDITURE.

Cr.	1841.			1842			1843.			1844.		
	£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*	£.	*s.*	*d.*
In each year, the dividend of 60*l.* per share, on 180 shares, amounted to	10,800	0	0	10,800	0	0	10,800	0	0	10,800	0	0
The loans paid off were	6,700	0	0	25,500	0	0	11,350	0	0	5,303	15	4
Interest paid on loans	1,958	0	2	1,206	1	10	647	0	6	99	14	4
The ordinary expenses were	17,482	8	3	15,548	6	1	4,234 12,392	18 12	10* 8	4,258 14,632	0 4	5 8
Extraordinary expenses, including improvements	3,365	5	5	1,790	1	8	2,061	14	4	6,595	0	10
Law expenses	819	0	0	1,307	15	9	2,164	15	3	938	7	11
Testimonials to Counsel and Secretary	..			..			..			305	0	0
Balances left in hand	32,325	6	3	19,603	11	11	19,445	3	10	32,517	15	5
Out of which dividends were ordered	10,800	0	0	10,800	0	0	10,800	0	0	10,800	0	0
Leaving for liquidation of debts, construction or reserved fund	21,525	6	3	8,803	11	11	8,645	3	10			
For construction account	..			..			..			10,000	0	0
And for sundry works ordered last year, and now in progress	.			..			.			11,717	15	5
The debt on construction account was, at the commencement of the year	48,853	15	4	42,153	15	4	16,653	15	4	5,303	15	4†
And at its close	42,153	15	4	16,653	15	4	6,803	15	4	97,414	3	1‡

* Rates, Taxes, &c., (not including Watchmen, Gatemen 2,020*l.* 10*s.* 9*d.* in 1843, and 2,058*l.* 17*s.* 10*d.* in 1844.)
† Paid January 31st, 1844.
‡ New construction account for Victoria and Railway Docks, &c.

RECIPROCITY RETURNS.

Return to the House of Commons of the payments made out of the consolidated Duties of Customs for the difference of rates and charges due on Foreign vessels, which, under treaties of reciprocity or otherwise, are admitted into the ports of the United Kingdom at the same rates of charge as British vessels.

HULL DOCK COMPANY.—DOCK DUES.

Year.	£.	*s.*	*d.*	Year.	£.	*s.*	*d.*	Year.	£.	*s.*	*d.*	Year.	£.	*s.*	*d.*
1820 ..	25	7	6	1826 ..	3,487	16	2	1832 ..	1,913	10	0	1838 ..	5,469	6	8
1821 ..	18	18	3	1827 ..	3,485	4	0	1833 ..	3,328	11	4	1839 ..	8,069	14	11
1822 ..	77	5	3	1828 ..	2,510	12	1	1834 ..	2,702	11	4	1840 ..	7,323	16	7
1823 ..	36	6	3	1829 ..	3,287	4	1	1835 ..	3,616	5	0	1841 ..	6,457	19	5
1824 ..	1,443	9	6	1830 ..	2,498	1	0	1836 ..	4,572	12	2	1842 ..	5,803	13	8
1825 ..	4,340	14	8	1831 ..	3,527	18	10	1837 ..	4,069	9	11	1843 ..	6,421	10	1

CORPORATION OF THE BOROUGH OF HULL.—HARBOUR DUES.

Year.	£.	*s.*	*d.*	Year.	£.	*s.*	*d.*	Year.	£.	*s.*	*d.*	Year.	£.	*s.*	*a.*
1820 ..	4	17	6	1828 ..	885	18	0	1834 ..	950	13	2	1839 ..	2,436	7	4
1821 to 1823	*Nil.*			1829 ..	1,426	10	8	1835 ..	1,057	13	0	1840 ..	2,648	0	0
1824 ..	151	5	6	1830 ..	817	14	10	1836 ..	1,309	13	4	1841 ..	1,080	10	4
1825 ..	1,454	19	3	1831 ..	1,169	6	6	1837 ..	988	1	8	1842 ..	2,527	8	7
1826 ..	1,331	6	8	1832 ..	818	4	2	1838 ..	1,914	1	6	1843 ..	1,407	18	10
1827 ..	922	9	10	1833 ..	957	19	8								

HULL TRINITY HOUSE.—PILOTAGE.

Year.	£.	*s.*	*d.*	Year.	£.	*s.*	*d.*	Year.	£.	*s.*	*d.*	Year.	£.	*s.*	*d.*
1820 to 1825 ..	*Nil.*			1830 ..	40	14	0	1835 ..	43	13	0	1840 ..	72	10	0
1826 ..	88	14	0	1831 ..	40	0	0	1836 ..	37	0	0	1841 ..	82	8	9
1827 ..	91	4	0	1832 ..	72	2	0	1837 ..	70	13	9	1842 ..	87	0	10
1828 ..	24	16	0	1833 ..	42	2	0	1838 ..	29	5	0	1843 ..	44	6	3
1829 ..	57	19	0	1834 ..	40	8	0	1839 ..	76	0	0				

HULL TRINITY HOUSE.—HARBOUR DUES.

Year.	£.	*s.*	*d.*	Year.	£.	*s.*	*d.*	Year.	£.	*s.*	*d.*	Year.	£.	*s.*	*d.*
1820 ..	1	18	8	1826 ..	1,706	10	2	1832 ..	1,620	8	6	1838 ..	2,942	3	6
1821 ..	0	0	0	1827 ..	1,348	14	2	1833 ..	2,374	3	0	1839 ..	4,617	9	0
1822 ..	23	14	2	1828 ..	1,250	10	8	1834 ..	1,502	19	2	1840 ..	5,658	3	8
1823 ..	0	0	0	1829 ..	1,877	0	8	1835 ..	1,854	12	4	1841 ..	4,216	18	6
1824 ..	28	17	4	1830 ..	1,556	15	10	1836 ..	2,071	6	10	1842 ..	4,533	19	6
1825 ..	1,747	2	6	1831 ..	2,230	6	2	1837 ..	1,823	10	0	1843 ..	4,431	11	2

APPENDIX B.

HULL.

River Humber.

No. 218.

Reciprocity Returns.

PROPRIETORS OF SPURN.—LIGHTS.

Year.	£.	s.	d.	Year.	£.	s.	d.	Year.	£.	s.	d.	Year.	
1820 ..	*Nil.*			1828 ..	762	11	10	1835 ..	1,000	18	0	1842 1848	Ceased on the purchase of the lights, by the corporation of the Trinity House, London.
1821 ..	10	10	9	1829 ..	898	9	10½	1836 ..	1,349	13	10½		
1822 ..	7	6	9	1830 ..	568	11	7	1837 ..	1,646	19	2½		
1823 ..	14	5	1	1831 ..	1,216	14	1	1838 ..	1,569	5	5		
1824 ..	10	8	3	1832 ..	1,275	16	9½	1839 ..	1,696	17	11		
1825 ..	614	11	3	1833 ..	732	8	1	1840 ..	1,438	15	2		
1826 ..	1,181	13	11	1834 ..	591	2	3½	1841 ..	2,861	18	6		
1827 ..	1,638	3	9										

HULL PILOT AND BALLAST OFFICE.—PILOTAGE.

Year.	£.	s.	d.	Year.	£.	s.	d.	Year.	£.	s.	d.	Year.	£.	s.	d.
1820 to 1821 ..	*Nil.*			1825 ..	1,083	17	7	1828 ..	484	2	11	1831 ..	717	16	8
1822 ..	15	5	0	1826 ..	743	4	7	1829 ..	710	6	6	1832 ..	300	3	9
1823 ..	0	0	0	1827 ..	677	18	11	1830 ..	542	7	8	1833 Ceased this year			
1824 ..	135	16	6												

No. 219.

Report of J. M. RENDEL, Esq., *on the Hull Docks.*

No. 219.

Rendel's Report on the Hull Docks.

GENTLEMEN,

34, *Great George-street, Westminster, 20th April,* 1840.

In submitting the following report descriptive of the accompanying design for additional docks at Hull, I would premise that since my return from the inspection of the port on the 8th ultimo, I have given almost unremitting attention to the facts and opinions collected on my survey; and have made myself well acquainted with the several plans which, during the last few years, different engineers have proposed for effecting this object. I would further remark that I have, in the course of my investigation, derived advantage from the statements of the several gentlemen, introduced to me as holding opinions differing from those of my employers, for by a comparison of the arguments advanced by each party and interest in support of their favourite plans, I acquired a much greater amount of local information than the shortness of my acquaintance with the port would have otherwise permitted.

The want of accommodation for steam vessels is the most striking defect. This is so great as to amount to a charge against the port by strangers, which is admitted by the resident merchants and traders of the town, who justly feel that, whilst they have so largely participated in the vast benefits conferred by steam navigation, nothing has been effected by those entrusted with the great revenues of the harbour for the accommodation of this lucrative and important branch of its commerce and traffic.

This fact, impressed upon me by my own observation and the admission of all parties with whom I conversed, whilst making my survey, has had due influence in the arrangement of the accompanying design.

Another great defect in the convenience of the port is, the want of warehouses contiguous to the docks, or rather is the existence of the only authorized warehouses at a distance from the docks. This is an inconvenience which may be less felt, from the fact that it has grown up with the trade and prosperity of the port. It is, however, becoming daily more obvious and embarrassing.

Under existing circumstances, that is, having due regard to the rights of property, the remedy of this evil is to convert the old harbour, on which the principal existing warehouses are situated, into a dock, and by so doing accomplish the additional accommodation now required for commercial shipping, on the site which is furnished with the requisite warehouses possessed by individuals, out of whose exertions and enterprise the necessity for this increased accommodation has originated.

Another important branch of the shipping of the port seems to require additional convenience—I mean, the trows and river craft. The only place where these vessels can now find accommodation is in the confined mouth of the old harbour, where they are so often crowded together as to occasion damage to themselves and to their cargoes. I therefore deem it important in any plan for the improvement of the port, to provide more room for the great number of this class of vessels.

First, for the accommodation of steam vessels, I propose to construct a pier off the present Humber Dock Basin, in the position shown on the design. At present there are from nine to ten feet of water at low water of spring tides at this site; the depth would, however, soon increase from the line of the pier being that of the currents of tide. I also propose to project the wharf wall, forming the west side of the Humber Dock Basin, to within 100 yards of this pier, and to form a connexion between the wharf and pier by a bridge, constructed to admit the flux and reflux of the tide to pass fully through it.

We should thus have a pier 600 feet long, capable of accommodating at all times of tide the largest class of steamers, and a wharf within the Humber Dock Basin 500 feet long, and both in immediate connexion with the terminus of the railway. This accommodation is the most suitable to that class of steamers which remains but a short time in port. For those which trade to foreign ports, dock accommodation is necessary. This I propose to afford by forming a new lock of ample size into the Humber Dock, which, from its proximity to the railway station, as well as other circumstances, is very appropriate for this class of shipping.

Secondly. In order to convert the old harbour into the necessary additional dock, I propose to cut a new channel for the River Hull, from Thornton-street, along the east side of the Citadel, as shown in the design. The whole of the present channel, therefore, south of this new cut, is available; and, according to the proposed plan, affords a dock of 17 acres' area, with 4700 feet of wharfage, one-third of which is ready furnished with the most convenient and commodious warehouses of the port.

APPENDIX B.
HULL.
River Humber.
No. 2.9.
Rendel's Report on the Hull Docks

The southern part of this dock would be upwards of 500 feet in width, and the northern end or narrow part of the present harbour I propose to widen on the east side, still leaving a sufficient depth between the dock and Tower-street for wharfs. The principal entrance would be by a lock from the Humber, but I propose another entrance from the River Hull, or rather at the junction of the Old and New River Channels.

For sheltering the principal lock and wharf from it to "Old South End," I propose to construct a breakwater, 300 feet from, and parallel to, the south or Humber wall of the dock, in the same line as the steam-boat pier before described, but with an opening of 250 feet between the two, for the easy passage of all classes of vessels.

Thirdly. For the greater security of the trows and river craft, I propose to form a basin in the new channel for the River Hull, at its outfall into the Humber, as shown on the plan. This basin is also designed to answer as an entrance to an additional dock (marked upon the plan) in connection with the present proposed dock, whenever the same may be necessary. In addition to this basin and new river channel, by the particular arrangement of the design, the whole area within the proposed steam-boat pier and breakwater, embracing the shore from the west side of the Humber Dock Basin to "Old South End," is formed into a sheltered harbour, well adapted to the ferry and other small class of steam boats and the river craft.

Having given a general description of the design, I shall briefly allude to such engineering points as will establish its practicability, and show its adaptation to the local peculiarities of the river.

The steam-boat pier and breakwater would be most conveniently and economically constructed of timber-piled work, filled in with chalk, in the same way that the present jetties are, and which, there being no worms in this river, are very durable structures. The bridge also, for connecting the steam-boat pier with the shore and railway, would be built on piles, so as to present the least possible obstruction to the tide.

The wharfs, locks, and other erections which the design embraces, would be built of stone and brick on piled foundations, in the same manner, or rather on the same principle, as the existing docks have been constructed, the nature of the ground being the same, as appears from a boring made at my instance at the mouth of the old harbour.

It has been thought by some that the ponding of water in the old harbour, necessary for converting it into a dock, would endanger the safety and usefulness of the numerous cellars belonging to the warehouses there. This fear, however, proceeds from the fact being overlooked that a new wharf wall will have to be built as a boundary to the dock against these cellars, which will greatly add to their security; indeed, give an opportunity to their proprietors to heighten and ventilate them.

In excavating the new channel for the Hull River, it is obvious there will be no difficulties, and the excavated soil may be advantageously used in raising the surface of the marshes on the east, marked on the plan as a site for ship-builders' yards, &c. The eastern pier, forming the basin or harbour at the mouth of this new channel, might, for economy, be built like the steam-boat pier, &c., of timber, filled in with chalk. Its proper projection into the Humber would be determined as it proceeded. I have, therefore, marked two lines on the plan, denoting its head.

It is indisputable that in a river such as the Humber, any pier or jetty run off from the shore, in a direction across the stream of tide or river current, will necessarily accelerate the accumulation of the land, or, in other words, by stopping the current and causing still water, a deposit of the mud which floats with the river will take place as far as the obstruction extends its influence on the stream. Hence it is that in rivers of this description—I mean where the water is surcharged with mud—all obstructions which tend to divert its current from the line of the shore should be avoided, or where found necessary for the convenience of trade, they should not extend beyond the limits to which the land might encroach upon the river without injury to the channels and general economy of the harbour.

In the present case, the works can be most advantageously adapted to the requirements of the trade by an encroachment on the shore between the present low and high water; but I have limited this encroachment to the extent to which land would be formed in the course of a few years, in case the plans now before Parliament for additional docks should be executed. The projection of the piers forming the entrance basin, in the plans just alluded to, is co-extensive with the projection of the eastern pier in my design, and the works westward along the river are limited to, or rather confined within, a line drawn from this pier to the bend in the shore at the west end of "Humber Bank;" consequently that portion of the shore which would inevitably be silted up, in case the plans now before Parliament were carried into effect.

This encroachment is so trifling, compared with the great width of the river, that it ceases to be an objection, as far as the general economy of the harbour is concerned; but as a consequence of the before-mentioned plan, it would be highly objectionable, by increasing the extent of mud banks and foreshore in front of the present Humber Dock Basin, and also at the entrance of the old harbour.

The steam-boat pier and breakwater being built in the line both of flood and ebb tide, the current would tend to deepen the water on each side of them.

As to any accumulations of silt in the basins, that could only be felt as at present; indeed not so much as the extension of the wharfs, &c., further into the channel of the Humber, would allow a more convenient arrangement for sluicing than now exists.

As the River Hull is extensively used for inland navigation, and drains a large and most valuable tract of country, any plan which in the remotest degree affected or endangered either navigation or drainage, could not be countenanced for a moment. By the plan I propose, the outfall of this river would be greatly improved, being both widened and deepened. The condition of the present outfall is very bad; indeed, the whole of the old harbour is in the most neglected state, and forms a series of obstructions from the North Bridge downward, so that the water continues to run out of the Hull, after it is one hour's flood (spring tides) in the Humber at its outfall.

As to the drainage of the town, the dock, as proposed by this design, offers no impediment, for the drainage may be carried through High-street, and emptied into the Humber, where the new works are connected with "Old South End."

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As regards the Citadel, the works cannot be deemed more objectionable than those of any other plan; indeed, not so much so as docks on the east of the Citadel. The approaches from Hull would be greatly improved, both in a civil and military point of view, there being two direct roads, viz., one over the north lock from Salthouse-lane, and the other from Old South End over the Humber Lock. But it is to be hoped that the time is not distant, when this almost useless Citadel will be abandoned, and its dangerous magazines removed to a distance from the town and shipping. Looking forward to such an event, its site would afford space for the most ample dock and port accommodation, and this circumstance adds to the value of the design now proposed.

Until I have before me plans and sections of the old harbour and Humber shore, made from actual survey, it would be a waste of time to go into a calculation of the quantity of works involved in the proposed design, so as to estimate the cost of carrying it into effect. I may, however, state generally that it is the least expensive plan of any which I could devise, having the same extent of accommodation. If it should be required to specify the amount of cost, then I must cause the surveys before named to be made, which will occupy at least a fortnight from the time the surveyor commences his operations.

I have, &c.,

To the Harbour Committee of the Port of Hull. J. M. RENDEL.

No. 220.

Hartley, on the New Docks of Hull.

No. 220.

Report of J. B. HARTLEY, Esq., C.E., *on the New Docks of Hull.*

SIR, *Liverpool, 6th February*, 1843.

HAVING, on the 12th December last, received from your secretary a resolution, passed at a meeting of your Company, on the 5th December, to the effect,—"That the consulting engineer be directed to attend in Hull to survey the port and its localities, and make himself generally acquainted therewith, from all or any sources, without any restriction whatever, with a view of laying before the Dock Company, at the earliest possible period, his opinion as to the most eligible site for a new dock, taking into consideration the general welfare of the commercial and shipping interests of the port, and that he prepare plans and estimates of the probable cost of the same, and that previously sufficient notice be given, that the engineer will attend at the Dock-office to receive information on the subject from all parties who may wish to impart it,"—I beg to inform you, that I proceeded to Hull on the 13th December, and having attended a meeting of your Company on the 14th, and given a day to the inspection of the various sites suggested by different parties as proper for a new dock, I left my assistant, Mr. Fletcher, to take some soundings in the harbour, &c., and obtain for me various information requisite for my guidance; having obtained which, I again proceeded to Hull on the 2nd of January, and in compliance with a notice given to the public, I attended at the Dock-office each day, from the 3rd to the 9th of January inclusive, during which time I was favoured with calls from a considerable number of gentlemen, from whom I received extensive information on the subject of the wants of the port, which, although very contradictory, was at the same time exceedingly instructive.

It is not to be wondered at, in a sea-port like Hull, that interests exist at variance with each other, on all of which the welfare of the port is so far depending, that to promote the one and neglect the others will be alike prejudicial to all; I have consequently felt bound to adhere strictly to the spirit of my instructions, and in any conclusions I have come to, I have, in all cases, "taken into consideration the general welfare of the commercial and shipping interests of the port," and been guided thereby.

There can be, I imagine, but little diversity of opinion as to the convenient general arrangement of the present docks at Hull, situated as they are in the very heart of the town, close to the seats of business, at but trifling distances from the places of deposit, and admirably connected with the various means of internal communication; which advantages can scarcely be denied to be of the greatest practical utility, and should, I am of opinion, be made available to the fullest extent in connection with any extension of dock space that may be determined upon. It must be a grievous sight for those who know and are suffering from the want of dock accommodation, to see the quays of the present docks occupied by vessels lying up for the season for sale or other causes, to the prejudice of all vessels requiring quay room and despatch, which I fear cannot be remedied unless under a new and more stringent system of supervision and management. One of the greatest evils to which the port of Hull is at present subject, arises from the practice of discharging timber into the docks, and passing it in rafts or singly through the locks, either into the river Hull or the Humber; the extent to which this is carried will perhaps be better understood by my stating, from information received during the inquiry, that, during the months of July, August, September, and October, upwards of twenty vessels are usually discharging daily into the docks from 1500 to 2000 logs; of these not more than from 500 to 600 can be passed through the lock, leaving a daily accumulation of from 1000 to 1500 pieces, which, it may readily be conceived, must create no little confusion and inconvenience by occupying dock space which ought to be otherwise employed, as well as causing a most objectionable detention to vessels requiring a passage from one dock to another. To remedy these inconveniences, and open to the utmost the capabilities of the present docks, adapted as they are to the wants of the trade of the port, should, I am of opinion, be our first endeavour; to effect which, it seems, no other means can be taken than to construct a new dock, capable of offering such facilities to those vessels incommoding the present docks as will remove them thence with advantage to themselves, and for the general benefit of the commercial and shipping interest. If, indeed, we take the timber trade alone, amounting as it does to about 130,000 tons out of 660,000 tons, or nearly one-fifth of the trade, and ease the docks thereof, the effect will be that of virtually increasing the present dock accommodation to at the least the same extent, and to the increased advantage of all the interests now benefiting therefrom; but the good resulting from such a measure cannot be adequately judged of from this view alone; we must bear in mind that with the vessels we free the docks from all the disadvantages attendant thereon, both as regards the timber floating in the docks and occupying the lock (particularly that from the old dock into the river Hull) the greatest part of the tide, but also of those vessels loading both timber and other produce for the interior of the country. Neither do the advantages to be thus derived stop here, but will extend to the old harbour likewise, which is not only crowded at times with small vessels loaded with or taking in timber, with vessels detained

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from entering the old dock by the timber coming out, but also with rafted timber coming down the river Hull from the yards above bridge, as well as that intended for the yards on the east side of the old harbour, which, being hauled up slip-ways at tide time, and lying as it does athwart the stream, is a great source of inconvenience and detention to vessels passing up and down the river. The present wants of the ports, then, as far as regards dock accommodation, may be stated as being dock space for the timber trade, and length and width of quay space for the general shipping and steam trade; to meet which my attention was drawn to various sites and designs. It is not my intention to canvass the details of any design, my consideration having been directed altogether to the principles upon which the wants of the port are sought to be provided for, which may be thus enumerated—

1st. The construction of a dock upon Dock Green, or Mr. Broadley's land;
2nd. The construction of a dock upon the West Foreshore, as proposed by the Railway Companies;
3rd. The conversion of the old harbour into a floating dock; and,
4th. The construction of a dock to the east of the old harbour, or upon the citadel ground.

Had I been directed to provide increased facilities for any particular branch of the many important trades centred in the port of Hull, I could have had but little difficulty; but when I am called upon to concentrate in my design the interests of all, I must confess, after the opposing nature of the evidence I heard during my attendance in Hull, I felt considerable diffidence in the prosecution of my task. Having, however, given the subject my lengthened and close consideration, I feel convinced that the design I now have the honour to submit to you will, when fully carried out, make Hull for its size one of the most convenient ports in the kingdom; and I cannot but anticipate that each step taken towards its completion will be felt beneficial to the wants of all parties.

Before entering into a description of what I would propose, it may be, perhaps, advisable to state my objections to some of the sites advocated by those seeking an extension of dock accommodation, which objections I need scarcely say have arisen, not only from the information I have obtained from all, but from my own consideration of "the general welfare of the commercial and shipping interests of the port."

In the first place, as regards the construction of a dock upon Dock Green, I am of opinion that a fatal obstacle arises in the incapacity of the Humber Dock entrance to afford sufficient convenience for the ingress and egress of more shipping than it does at present, and there can be no doubt that it is insufficient for the proper working of those docks now dependent upon it. To this objection it was replied that an entrance might be made from the Humber further to the westward. This certainly is practicable, but very far from convenient, as not only would the communication thus made cross the main line of the railway, but the basin, forming the entrance, would have to be projected so far into the Humber, to obtain sufficient depth of water, as would not only be objectionable in itself, but prejudicial to the existing entrances, both to the Humber basin and old harbour, unless very expensive works were constructed at the same time to prevent such effect. Neither do I think this site offers that accommodation which the wants of the port require; as the greatest available width to be obtained, without interfering with the burial-ground, is about 500 feet, and is too limited to afford quays sufficiently spacious, when a dock of convenient dimensions has been subtracted from it. It must also be remembered, that the vacant piece of ground, called Dock Green, is of itself totally inadequate for the construction of an efficient dock, and that much land, now occupied by buildings, &c., would have to be purchased both for the dock and its connexion with the Humber; and though beyond my province, and with but a comparatively slight knowledge of your town, I cannot but imagine that the expense thus incurred, would be far greater than the advantages to be derived therefrom would repay. I do not think it necessary to enter more fully into the consideration of this site, as I did not find it very strongly advocated by any, particularly when I pointed out the inconveniences connected with it.

The next site to be considered is that of the West Foreshore, which the Railway Companies, and others interested in trades requiring a close communication therewith, are desirous should be chosen for the construction of a new dock. For a railway dock, but little hesitation need be had in coming to the conclusion that this site would be convenient and advantageous to those who now so strongly urge its necessity; but that it would, in like manner, be beneficial to the general interests of the port is to me somewhat doubtful. My decided opinion with regard to the interests of the trade of your port is, that the timber trade should be kept entirely separate from the general trade, the conveniences required for each being so distinct and different, that neither can be carried on advantageously in connexion with the other. The quays, for instance, of a dock appropriated to general trade, should be provided with sheds for the protection of the goods landed or discharged, which would be, at the least, an inconvenience to a ship having to discharge timber, as the quays for this purpose should be considerably lower, to allow of the timber being hauled out of the bow or stern-ports immediately on to the quay, and this system would not be convenient to a vessel having to discharge broadside on, requiring the quay as near the level of her deck as possible. Any design, therefore, intended for the general benefit of your port, should provide such accommodation for the discharging of timber ships, as would not only withdraw them from the present docks, which are not suited to them, but also supersede the necessity of discharging timber into the docks, a system which cannot be too much deprecated, by providing quays sufficiently spacious to admit of a cargo being speedily discharged, with advantage and security to the owner, and satisfaction to the revenue. These advantages, I am of opinion, cannot be obtained on the West Foreshore site to the extent that the general interest of the port requires. The design contemplated by the Railway Companies only extends 640 feet from the verge of the railway to the coping of the proposed river wall, and even this overlaps the entrance to the Humber Dock basin to a very prejudicial extent; nor is there here any opportunity for a further extension at a future time, should circumstances require it, except to the westward, the railway forming a boundary on the land side, which must ever be felt as a bar to the formation of convenient docks in this direction. A quay at the least 250 feet wide should be appropriated for the discharge of timber; and it is not to be expected that a merchant would be satisfied with even this, unless his yard was not far distant. Again, a dock to allow of timber being discharged in a proper manner, should be at the least three ships' lengths in width, to allow of a clear middle passage when ships are lying end on to the quays at each side. To obtain these advantages on the site we are now considering is out of the question, and as the present docks cannot provide them, we must seek such other site as will afford all the conveniences we require.

It must not be supposed, from my bringing forward the timber trade so prominently as an objection to this site, that I am interested for the advantage of that trade alone; on the contrary, I was favoured with fewer interviews with those connected with that trade than any other; but I feel so

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strongly convinced that the present facilities will afford such great relief to the wants of the port, if eased of the disadvantages attendant upon this trade, that I am of opinion if you provide the accommodation it requires, you will be providing for the wants of all; my object being to remove the timber trade completely out of the way of the general trade.

There is an objection to a dock having an entrance much further to the westward than that of the Humber Basin, in the shoaling of the Foreshore to the southward, which would prevent deep water being obtained, and be much more liable to a deposit of mud. It must be borne in mind that the vertical rise of tide in the Humber opposite to Hull is, at spring tides, but 22 feet, and on examining the register of the height of the tides upon the Humber Dock sill during 1842, I find that the highest tide was 28·9, from which must be deducted 5 feet which that sill lies below low water of spring tides, giving 23·9 as the highest vertical rise; the tides, however, reached a 23-feet rise but three times during the year, and seldom rose to 22 feet. For this reason it is found necessary to lay the sills of the dock gates so much below low water, as will give a sufficient average depth of water to afford the usual class of vessels ingress and egress at all tides. The Humber Dock sill is, as I have before observed, 5 feet below the level of low-water spring tides, and many complaints were made to me of its being too high; it appears, however, from the soundings I had taken, that there is a depth of 2 feet more water on that sill than between the outer piers of the basin; so that any vessel which can get into the basin at all must have sufficient water into the dock; showing that no ordinary sluicing can be made efficient, when it has to act for any distance through a body of still water, the effect being that a deep hole is made in the mud where the force is first felt, and chiefly spent, and as that force expands and decreases, so does the effect cease and the mud shoal. If, then, a dock to the westward is to maintain a depth of water equal to that into the Humber Dock, and less will be very inconvenient, how great will be the difficulty, when we consider that shoal water extends very considerably further out into the river, that the scour will not be in a direct line but at right angles to its entrance, and that the Humber Dock, which has a straight scour and an ample supply of water for the purpose, is yet unable to keep the depth through the entrance of its basin, though at a shorter distance, as great as the depth upon the sill. This objection, which I think a serious one to the Railway Companies' design, will apply with a still greater force to the entrance basin proposed at the west end of their western dock, as the distance to a sufficient depth of water at low water increases greatly, and I am of opinion that 5 feet at low-water spring tides could not be in any way maintained, except by continual dredging at an enormous expense. The projection of this work into the Humber to the extent proposed will be very prejudicial to the entrance of the existing docks, both on the flood and ebb tides, as slack water will be produced immediately in front of the Humber Basin entrance, which you are well aware is the certain cause of a deposit taking place, and I think I have already shown you that your scouring power is not sufficient to prevent it. Though the effect I have described will of course be most materially experienced at the entrance to this basin, it will also be injurious not only to the Ferry-Boat Dock but likewise to the Old Harbour entrance, as the slack water will be extended in-shore of the projection. The entrance into the Old Harbour is a strong exemplification of this effect as it now exists, the projections that have been made from time to time to the westward having caused the East Foreshore to warp up, until what used to be the point of departure for ships going to sea will not now float a small boat; a further projection will naturally cause a further deposit, and by throwing the bar which at present exists still further out of the action of the tide, most serious injury to the navigation of the river Hull may be the result.

I now come to the consideration of the third site, or to the design for converting the Old Harbour into a dock. Although I cannot enter fully into the views of those advocating the necessity of this design, or bring myself to think that its immediate adoption will give that relief the wants of the port require, still I am of opinion that a time may come, and that before long, when the conversion of the Old Harbour into a dock will be a matter of great convenience to the general interests of the town of Hull.

According to the opinion I have formed of the present necessities of your port, I do not think that making the river Hull into a dock would be of any great advantage, as it would be merely rendering a space now sufficiently crowded with shipping, and available during 9 hours out of 12, into a floating space during all times of the tide; and though it cannot be denied that considerable advantages would accrue therefrom, yet disadvantages would arise from its adoption requiring some consideration. One great advantage at present derived from the Old Harbour is, that the description of vessels chiefly using it can now run into it very early, and depart from it very late upon the tide, and that it affords the only refuge they can avail themselves of, should they be compelled to bear up in tempestuous weather; and although in carrying out the design, a new channel for the waters of the Hull is by some proposed, still that channel must be far from those places where the business of these vessels is located, far from the town, and by no means adapted for their convenience.

If we consider the advantages to be gained by this design, unconnected with any other, I cannot, I must confess, foresee any great general benefit that can arise therefrom: its dimensions, so far as regards width, are confined, its banks and quays are all appropriated, and its public approaches are too limited to be made practically available, except at a considerable expense; and, supposing this expense incurred, the only advantage to be gained therefrom is, having the vessels using it afloat six more hours out of the twenty-four than at present, and a communication with the existing docks at all times of tide; these, I allow, are benefits of some importance to those occupying its margin, and not to be lost sight of, but I am not of opinion that this design would relieve the present docks to the extent required, or that its advantages would be commensurate with the cost; nevertheless, I am so far from thinking it unadvisable that, it will be seen, I have made its eventual adoption a feature in the designs I herewith lay before you for the future improvement of your port.

I will now proceed to a description of my own design, though I can by no means lay claim to any great degree of originality, when so many have occupied the ground before me with so much ingenuity.

In submitting this plan to you, it must not be supposed that I consider the present wants of your port require the immediate completion of all proposed therein; on the contrary, I have confident hopes that the portion I would first recommend you to adopt will afford such relief, and so great advantages, that the remainder will be called for at a future period by the rapid increase of the trade. Many of the evils under which Hull is now labouring arise from its river works having been constructed to meet the pressing wants of the moment, but without any connexion or design for the future extension of its docks, and evidently with but little consideration of what effect the works might have on other portions of the river; I have consequently been led to anticipate what may be required, and I have

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endeavoured to design such a plan that each portion will be distinct and complete in itself, and harmonize well together when connected as a whole.

In the first place, then, I would recommend your constructing a dock upon the citadel-ground, if the terms on which the Government will sell it are such as to justify its purchase. This dock, the design for which I have laid down upon a general plan of the port, I would advise being constructed with an entrance at its north-west end, communicating with the Old Harbour by means of a lock 45 feet in width and 180 feet long, inside the chamber. In connecting this dock with the Old Harbour, it will be perceived that I have formed an outer recess adjoining the lock, having its walls splaying both ways up and down the river; the object of which is to avoid as much as possible the inconvenience attending ships hauling out into the stream at right angles to the current, either on going to sea or proceeding to the upper docks, to the inconvenience of other vessels going up or down; this there can be no difficulty in keeping free from mud by efficient sluicing at low water, or on the last quarter ebb (the fall to be obtained ensuring its effect), and it will afford an area for the reception of the small craft waiting to lock into dock, or going to sea, out of the way of the general traffic of the river Hull. The dock itself, I would advise being made about 430 feet in width, and having an area of about 12¾ acres. The quay on the side next the contemplated new citadel I propose making 200 feet wide, which may be appropriated for deal-yards, or other similar purposes, reserving at all times a quay from 70 feet to 75 feet wide next the dock, for the benefit of other descriptions of vessels, on which sheds may be erected if required. The quay on the other or north side of the dock I would set apart for the reception of log timber, discharged from vessels directly thereon; and I would strongly recommend a clause being inserted in the Act to be obtained, preventing the discharge of any timber into the docks, except with the especial permission of the Dock Company. This quay I would lay out at the least 250 feet in width, independent of any street that may be required for general traffic, and the remaining depth beyond this I would appropriate for timber yards, to be let to the parties requiring them at as cheap a rate as would, with the additional convenience of having their vessels discharged immediately opposite the yard, and the little trouble connected therewith, induce them to prefer having their establishments in this locality to any other. It will be perceived that there is ample space to the north of the proposed dock to carry this idea fully into effect, without interfering with any building or property which might be difficult to obtain, or of great relative value; and although it may be thought injudicious to appropriate so great a space of ground to this purpose, still it must be remembered that by this means alone can the Company reserve to themselves the advantage of having space at their command, on which a future extension of dock-room in this direction can be obtained, at a comparatively small outlay, as this plan will allow of branch docks being formed either to the northward or eastward, without any expensive tidal works.

The connexion I would propose forming between this dock and the Humber is by means of a half-tide basin, 350 feet long by 300 feet in width, giving an area of about 2½ acres, the passage between which and the dock being 50 feet in width, furnished with one pair of gates, and crossed by means of a swing bridge. The outer or river entrance should be 60 feet wide, likewise furnished with a single pair of gates, but without a bridge; the sill of the outer gates I would advise being laid 6 feet below the low water of spring tides, and that of the inner gates at the same level as the Humber Dock sill; we shall thus have a depth of 19 feet at the lowest neaps, and 28 feet at the average spring tides, at the outer entrance, and 18 and 27 feet at the inner; so that vessels going to sea may haul out of the dock into the basin between tides, and be ready to depart as early on the tide as there is sufficient depth over the outer sill, and those vessels having to dock may haul in until a quarter ebb, when the gates being shut, the clows with which the inner passage is furnished must then be lifted, and the water run to a level in the dock and basin, when the connecting gates being opened the vessels may haul into dock, and others come into the basin to depart upon the ensuing tide.

The walls of the river entrance, it will be seen, are splayed east and west, the object of which is to facilitate the docking or undocking of vessels in the rapid tideway, as slack water will be formed in this recess, which will prevent the tide catching the bow or counter of a long ship ere she is clear of the narrow part of the entrance at the other end; these splayed walls will be furnished with several sluices, to prevent the accumulation of mud, and being so near deep water their power will be fully adequate to the purpose. In front of this entrance, at a distance of about 350 or 400 feet, I would advise a breakwater being constructed, somewhat on the principle of that designed by Mr. Oldham in his plan for the conversion of the Old Harbour into a dock; the only difference being that I would prefer the ends being formed more elliptical, to induce a greater concentration of tidal current inside, so as to secure an efficient scour. This will prevent the swell of the Humber setting in upon the gates during gales of wind from the S.E. to S.W., and will afford shelter for the river steamers and small craft, without offering any obstruction to the shipping or interfering with the use of the citadel guns.

The principle of the half-tide basin and its peculiarly formed entrance may appear theoretical to those who have not seen its practical operation, and the system of external gates may perhaps seem inconvenient, after being accustomed to consider an open tidal basin necessary for the protection of vessels docking, &c.; but so far is this from being the case, that although in Liverpool open tidal basins were originally attached to the docks, half-tide basins are now preferred and found highly advantageous, having been designed and first introduced by my father, Mr. Jesse Hartley, in the new docks; since which it has been seriously contemplated putting entrance gates on those which now remain open, one of the old dry basins being already thus altered into a half-tide basin with a 70 feet entrance.

I have formed the line of river frontage at the low-water mark of spring tides, and I am in hopes that although the Ordnance Board have shown their works extending only to the low-water mark of neap tides, they will make no difficulty to this further extension on our part or their own, as it is material that our river entrance should be as far to the southward as it can be got, not only for convenience of approach, but also for the securing and maintaining sufficient depth of water.

The want of public graving docks is, from the information I received, greatly felt at Hull, as there are none of sufficient capacity, whilst those there are, are in the hands of private individuals, and being entered from the river Hull, must be not only inconvenient but at times dangerous, particularly for heavy ships, from the short time they can have for docking and shoring on the top of the tide. I have, consequently, designed two graving docks, each 450 feet in length, having entrances 45 feet in width, opening out of the south end of the proposed new dock. The sills of these graving docks should be laid at the level of low water of neap tides, to allow the water being run out of them at all tides;

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all vessels drawing under 12 feet water could thus be docked at dead neap tides, whilst at spring tides any ship frequenting the port might be admitted; such an arrangement would, I conceive, afford every convenience of this nature at present required, excepting as regards the class of steamers larger than those using the Humber Dock; should it, however, be deemed desirable to have a graving dock constructed for a larger class of steamers, I would advise its being placed on the west side, and opening out of the present Humber Dock basin, as shown by dotted lines upon the plan. I do not anticipate your requiring this for some time to come, as it appears doubtful that the size of your steamers will be much increased, and I have but brought it forward as a portion of the general design for the extension of dock accommodation, when the trade may require it.

A strong objection has been urged against the construction of a dock to the eastward of the river Hull, in the want of a direct communication between it and the business parts of the town, as the distance round by the North Bridge would be inconveniently great. To obviate this, it has been proposed to construct a bridge across the Old Harbour at Scale-lane, and this idea seemed to be considered, by the most of those with whom I conversed on the subject, feasible and unattended with any great inconvenience. Few will hesitate, I imagine, in allowing that a second bridge across the river Hull is very desirable, and would be highly advantageous to the town in general, not only in case of an eastern dock being built, but under present circumstances, as it would afford a more convenient communication with the populous suburb on that side of the river, and divide the traffic for which the North Bridge is scarcely sufficiently spacious,—the entrance to the town from that direction over the Old Dock Bridge being also exceedingly inconvenient,—yet I do not think that Scale-lane is the best situation to place it in, as it will throw the greatly increased traffic into streets too confined to form fitting avenues to works of such magnitude, and incapable of being made sufficiently spacious except at a great cost. I therefore consider the position I have chosen for it more advantageous, being in a direct line with Humber-street, avoiding any very expensive work of communication with the main streets, and conveniently situated as connecting the proposed new dock with the railway depôt and steamers. It will also in this position form a part of the works required in converting the Old Harbour into a dock, and should be constructed, with this view, in the manner shown upon the plan, where the dotted lines point out the work of which this will form a portion. Another improvement I would suggest is, an alteration of the south wall of the entrance from the river Hull to the Old Dock, by splaying it considerably to the southward, and thus facilitating the ingress and egress of vessels using the Old Dock, and preventing large ships, when hauling in or out, from having to lie athwart the stream of the Hull, to the great detention of those vessels navigating that portion of the river; it will consequently afford not only facility to vessels passing from the new to the old docks, but, together with the suppression of the lockage of timber, will, I am convinced, go far to obviate the detention of the river craft, now so much and so justly complained of.

Having now explained to you in detail what, in my opinion, are the first steps to be taken in the extension of your port, as connected with the welfare of its commercial and shipping interests, I may shortly repeat the design to be, the making a new dock on the citadel ground as I have proposed, affording such facilities to the general, but especially to the timber trade, as will relieve the existing docks of their inconveniences, appropriating the Humber Dock as exclusively as may be to the steam trade, allowing the Railway Company to lay such lines of rails along its quays as they may require, so far as the general utility of the quays will permit; the giving the Junction Dock to those sailing vessels requiring, from the nature of their cargoes, a communication with the railway, and permitting the same facilities here as at the Humber Dock; and by reserving the Old Dock and its quays for the general indiscriminate trade of the port, exclusive of the timber trade.

In carrying these measures into execution, I would beg particularly to call your attention to the quay on the west side of the Junction Dock, which is somewhat inconveniently narrow, and I would strongly recommend that as much additional area be given to this quay as can be obtained by clearing away those buildings now existing upon it, which belong to the Dock Company, and widening it by such other additions as are practicable, so as to allow of a line of sheds being erected upon it when required, which would greatly increase the convenience of this dock and facilitate its connection with the railway. Much additional convenience might likewise be given to the approaches to the north quay of the Old Dock, both fron the town and the quay of the Junction Dock, by taking down some of the old buildings which belong to the Dock Company; and when the deal yards are removed from this site, and the quay widened and thrown open to the public, these improvements will necessarily be required.

These arrangements, together with having the whole of the quays made legal landing places, will, I feel assured, be of the greatest benefit to the port of Hull and to the trade of the town in general.

To render the working of your docks as efficient as they ought, it appears to me, from the evidence I have heard, very desirable that a head or responsible person should be appointed, who, receiving his instructions from time to time from the Company, should have the entire control of their dock establishment, and the whole of the servants connected therewith, and should be held accountable for any inefficiency in their management; without which no satisfaction can be expected, nor system carried out for the general benefit of the trade, in such a manner as would be desirable.

I now proceed to give a slight description of the other features of the design I have submitted to you, which will, I imagine, from their self-evident convenience, require but little explanation.

It has been much complained of, that the Humber Dock lock is too narrow to admit the largest class of steamers which have come to your port, and that it should be widened. Though there would be no great difficulty in effecting this improvement, there would be great expense and considerable inconvenience, as that entrance would have to be completely closed for some months during the alteration, and all vessels using the Humber Dock would have to go round by the river Hull, the Old, and the Junction Docks, to enter it, to the total exclusion of the steamers, which would then have no accommodation. I am, therefore, of opinion, that the best and most convenient method to adopt would be, to construct the new dock to the eastward in the first instance, and then, should the same feeling still exist with regard to the Humber Dock lock, to extend the present Humber Dock basin, some distance to the southward, and convert it into a half-tide basin having its river entrance furnished with a single pair of gates, 60 feet wide, and a lock to the westward, similar in capacity to that at the entrance of the Humber Dock, so that the largest steamers, which could not get through the lock into the Humber Dock, would find accommodation in the basin, and the other vessels and small craft might lock in and out as they now do. In connection with this work, when the steam trade shall have increased to require it, I would advise a dock being constructed on the south-end foreshore, where the Ferry-Boat Dock now exists, and extending down to low-water mark

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of spring tides, in a straight line east and west from the proposed alteration of the Humber Basin, to the intended new works to the eastward. To this dock I would place a main entrance at the east end, 60 feet wide, and at the west end I would form a lock suitable for the penning of small craft; thus affording a communication with all the other docks Perhaps the lock, which I have shown in dotted lines between this and the Humber Dock, might supersede the necessity of the smaller one, as I think it would be highly advantageous to have a second entrance into the Humber Dock, for should any casualty happen to the present lock, the working of those three docks would be entirely stopped, except what might be done through the old river. The north quay of this dock I have shown in a continuous line with that of the Humber Dock basin, and by taking down the houses between and Wellington-street, so as to afford a spacious quay, would form a valuable adjunct to the conveniences of the port, especially for the large first-class passenger steamers.

The remaining portion of the design is the conversion of the Old Harbour into a dock, by the construction of a lock at the bridge in continuation of Humber-street: this should be formed with 45-feet gates, and an enlarged chamber to facilitate the penning of small craft, and should be provided with powerful sluices, to maintain a deep-water channel, which with the assistance of the South-End Dock, there would be little difficulty of securing. This design will be completed, should it eventually be found advisable, by forming a large half-tide basin, at the mouth of the Old Harbour, into which both it and the South-end Dock would open: this I would furnish with gates 65 feet in width, having their sill laid 6 feet below the level of low water of spring tides, and would be found a most useful appendage, not so much from the quay space it would afford, but from the facilities it would give to ships going to or arriving from sea, congregating here until tide time, or the gates were closed, when they could haul out into the river, or proceed to their berths, without hurry and confusion. Breakwaters I consider essential before the entrances of all these tidal basins, not only as a protection to the gates, but also to promote the tidal scour, as I have before described. I have not entered into a consideration of the other detail of this design, or of the best means of constructing the works above the North Bridge required in converting the old river into a dock, my local knowledge not being as yet sufficient to enable me to speak with certainty on the subject; there can, however, I imagine, be no insuperable difficulty, and though there are ideas in some of the designs I have seen of great merit, especially that of Mr. Stickney's for supplying the docks with fresh water, still I think, on mature consideration, it will be found advisable to adopt the principle of Mr. Rendel's design, and divert the course of the River Hull from some point above the North Bridge, the bend near the cotton-mills appearing to me the most desirable, where a straight course for the river may be obtained through land of no great comparative value.

It would be premature in me giving any opinion now, as to which of the designed improvements should follow the construction of the East Dock; time alone can develop that by the wants of the trade; whatever is eventually carried into operation should only be decided upon after mature deliberation, as the effects of tidal works, if constructed injudiciously, are often of irremediable prejudice to the welfare of a port; you have still the opportunity in your hands, and I doubt not will take such advantage of it as will ensure convenience to the port, benefit to the town, and prosperity to all.

I would, in conclusion, beg to call your attention to the present state of the banks in the Humber, as connected with the town of Hull, which, from what I heard and what I have observed, should be now attentively watched, as there appears to be some fear from their recent extension, they may in a short time, if measures are not taken to prevent it, produce serious injury to your port: the object with you should be to keep the strength of the tidal currents of the Humber along the Yorkshire coast, and prevent as much as possible its set along that of Lincolnshire, for on this depends the possibility of preserving deep water opposite the town of Hull. If any clause could be inserted in your Act giving you power to act as conservators of the Humber, either under the Admiralty or not, it would be, I conceive, highly desirable; at all events, I would strongly recommend more attention being given to the deposit of the mud from your docks, and have the barges discharged, even though at an increased expense, to the southward of the middle sand.

I have, &c.,
JOHN B. HARTLEY.

To John Beadle, Esq.,
&c. &c. &c.

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Recorder's Opinion of the Liability of Corporation to cleanse the Harbour.

No. 221.

Recorder's Opinion on the Liability of Parties to Clean the Harbour at Hull.

Hull, 14th November, 1845.

SIR,

I find from the evidence given by the Town Clerk to the Commissioners for inquiring into the state of the Tidal Harbours of the country, on their recent visit to this port, that the case which had been laid before the Recorder for his opinion, as to who were the proper parties to cleanse the harbour, is represented as erroneously drawn up, and that had certain materials been inserted, the opinion given by the Recorder might have been different. I therefore transmit you a condensed copy of the case, together with the Recorder's opinion thereon, for publication, with the evidence received by the Commissioners on the inquiry alluded to, in order that it may be seen on what statement the opinion was given.

I am persuaded there is nothing in the charters of the corporation, subsequent to that of Richard II., which can in any degree vary the liability of the corporation to cleanse the haven, or which diverts the application of their dues entirely from this purpose; and in support of this view I would refer to the report of the case alluded to in the Recorder's opinion, and to their own recent return to the House of Commons.

I am, Sir, your obedient Servant,
WILLIAM BUNNEY.

Mr. Thomas Wood, Hull.

The case laid before the Recorder for his opinion as to the parties liable to cleanse the harbour, set out by stating the extract from the charter of Richard II., in the 5th year of his reign, granting to the port of Hull, to the Mayor, Bailiffs, and Burgesses of that town, that the port so granted and then called Sayer Creek, was that part of the navigable river Hull, which bounds the town on the east, and which extended from a place called Sculcoates Gote, southward to the confluence of the river Hull with

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the Humber; that between these places the entrance to the Old Dock was situate, and until within a few years past, every vessel using that dock had to pass through that part of the river Hull, which constituted the original port called Sayer Creek; the place is now known by the name of the Haven or Old Harbour.

The case then stated that the corporation of the Mayor, &c., of Hull, by virtue of the above-mentioned or some subsequent charters from the Crown, claimed a right and title to certain tolls and dues payable on goods and merchandize imported and exported into or from the port, and by vessels frequenting this port that these tolls or dues were usually designated by the names of water-bailiff, anchorage, jettage, hostage, and ballastage dues; that the payment of these dues had been disputed, and were the subject of an action about the year 1774, the case of the Mayor of Hull *v.* Horner (Cowp. 102), from the report of which it appears that the corporation had proved on the trial of the action at Nisi Prius, that they had done certain repairs to the port out of such dues.

The case further stated that the corporation of the Mayor, &c., a few years ago returned the annual amount of these tolls or dues to the House of Commons, and that in such return they stated that "they were levied under the authority of their charters," and were appropriated "for maintaining and supporting the port or haven of the town, cleansing or removing all obstructions therefrom, also keeping in repair the banks, breast works, jetties, mooring posts, and other conveniences requisite for the free and safe navigation of the haven, and also maintaining and keeping in repair the public common staiths, on the west side of the said haven, and other burdens to which the corporation were liable."

The case then recited the 72 sec of the 14 Geo. III. (the first Dock Act), which gave the corporation an annual rent of 5*s*. out of every quay or wharf (except the common staiths aforesaid), which should be made by virtue of that Act on the west side of the said haven, "in lieu of and as full recompense and satisfaction for the right and interest of the corporation in and to the soil of the said port or harbour of Kingston-upon-Hull, and of their privilege of building houses, quays, and staiths, within the same."

The following clauses of the several Hull Docks are also set out in the case, namely, in the Act of 14 Geo. III., clauses 6, 7, 42, 44, 87, and 111, and in the Act of the 45 Geo. III., clause 5, and in that of the 7 and 8 Victoria, clauses 212 and 229.

The case further stated, that it appeared from the local histories of the town, whose compilers had been allowed access to the records of the corporation, that the corporation of the Mayor, &c., had in times past, but prior to the passing of the Dock Act, 14 Geo. III., cleansed the haven and removed obstructions therefrom; that the corporation of the Trinity House in Hull appointed under the authority of their charters the harbour-master of the port; and that this officer had complained to them of great and serious impediments existing to the navigation of the haven by the accumulation of mud banks, shoals, and other obstructions to shipping passing up and down, and which were daily increasing; that the complaints made by the haven-master had been communicated by the Trinity House to the corporation of the Mayor, Aldermen, and Burgesses, and also to the Dock Company and as the Trinity House considered the Dock Company to be the parties more immediately liable, under their own Act of parliament, 45 Geo. III., clause 5, to remove the obstructions complained of, they urgently requested that body so to do, who, however, repudiated any liability attaching to them in this respect.

The Trinity House had thereupon caused a survey to be taken of the actual state of the haven under the superintendence of a committee of their board, of a civil engineer, and of the haven-master, and finding by the report made to them that the danger and inconvenience arising to the navigation of the haven from the causes before mentioned was very great, they directed the opinion of the Recorder to be taken as to the liability of the Dock Company under the before-mentioned Act, 45 Geo. III., c. 5.

OPINION.

The opinion given by the Recorder on the above case is as follows:—

"I am of opinion that the municipal corporation of the borough are the proper parties to cleanse and remove the obstructions complained of. The port was granted to them by the charter of Richard II., and certain port duties (under the name of water-bailiff dues) had been taken by them avowedly upon consideration (amongst other things) of repairing and preserving the port. The charter of Charles II. describes one purpose of those dues to be 'the reparation, preservation, and defence of the port;' that they have actually made such repairs in many instances appears by the case in Cowper's reports, and by their own return to the House of Commons, wherein the dues are stated to be applied in maintaining and supporting 'the port or haven of the town, cleansing and removing all obstructions therefrom,' &c., &c., and other burdens to which the corporation are liable. I have no doubt, therefore, that, at all events, before the passing of the dock Acts the municipal corporation were liable to this burden. The only question then, is, whether by virtue of the dock Acts, the liability has been transferred to any body else,—I certainly cannot see that it has. The whole right to port dues is carefully preserved to the municipal corporation by the first dock Act, 14 Geo. III., c. 56, sec. 111, that is, the whole of the consideration on which they originally took the burden of repairing the port is retained by them. Besides sec. 22 of that Act contains an express provision as to what the Dock Company are to repair and cleanse, and certainly the haven is not included, nor can that be said to form any part of the consideration for the dock dues, as described in the beginning of sec. 42. If any obligation to cleanse and repair the haven has been imposed upon the Dock Company, it must have been by the 45 Geo. III., c. 42, s. 5; the words of that section appear to be permissive and not imperative; they give a power of cleansing, &c., which, as the soil is in the corporation (see sec. 72 of 14 Geo. III., c. 56), the company might not otherwise have had; words like these were held to be permissive only by the Court of Exchequer Chamber, in Pounceby *v.* Lancaster Canal Company, 11 Adol. and Ellis, p. 242, though the Canal Company were held liable upon a common law principle to remove an obstruction from the soil of the canal belonging to themselves. It is true that words of permission in a statute are sometimes held to be obligatory; for example, where it is for the public benefit, and where the object could not be obtained if the words were not deemed imperative; here, however, there is a primary liability on the corporation, which may be enforced, and therefore the necessity does not arise, unless indeed the water-bailiff dues, which are the proper fund for the purpose, should fail, so as to be no longer available for the repair and preservation of the port from which they issue. If that fund should become unavailable, perhaps the Dock Company might then be compellable to undertake the burthen, so that the public might always have a remedy; but for the reasons which I have now stated, I am of opinion that the primary liability belongs to the

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corporation. I do not attach much importance to the fact that the Dock Company have very lately removed a small vessel which had been sunk in the haven. This they may have thought it right to do in the exercise of the discretionary power vested in them by the 45 Geo. III. It is a very much stronger fact against the corporation, that long since the 45 Geo. III., they made their return to the House of Commons, stating that they applied the water-bailiff dues 'in maintaining and supporting the port or haven of the town, cleansing and removing all obstructions therefrom, and other burthens to which the corporation are liable.'

M. T. BAINES,

Recorder of Hull."

GRIMSBY.

No. 222.

Evidence taken on the 24th Oct., 1845.

No. 222.

PORT OF GRIMSBY.

Examining Commissioner—Captain WASHINGTON, R.N., F.R.S.

Present:—Lord WORSLEY, M.P.; GEORGE TOMLINE, Esq., M.P.; RICHD. THOROLD, Esq., *the Mayor*; Capt. MAITLAND, R.N.; G. M. WILLIAMS, Esq.; T. BELL, Esq., Lieut. HOWE, R.N.; G. BABB, Esq., &c., &c.

GEORGE BABB, solicitor and joint secretary with Lieut. Col. Humfrey of the Grimsby Dock Company, stated, that the first Act of Parliament for the improvement of the Port of Grimsby passed in 1796, viz, 36 Geo. III. c. 98, since which the Acts 39 Geo. III., c. 70, and 6 Geo. IV. had passed. That an Act of Parliament had been obtained the last Session of Parliament, for making additional docks and works, and a new company incorporated, called *The Grimsby Dock Company*. The dock dues received at the port were taken under the authority of the provisions of the last Act, and are more than one-third less than those received at the port of Hull; that no wharfage dues are at present taken by the Grimsby Dock Company. The tolls payable to the corporation of Grimsby, and all town and private dues, were abolished by the Act passed in 1796.

WILLIAM BROOKS stated he had been collector of dock dues and superintendent of the works for about eleven years. The amount of dues collected is about 1500*l.* annually, part of which has been expended annually in the repair of the works. The dock was completed in 1801: the late Mr. Rennie was the engineer. The dock-water is fresh water. It has been cleansed out twice; first, in 1826, by hand, and about three years since, by a dredger; the two cleansings cost upwards of 12,000*l.* The depth of the dock is 18 feet in the basin, 14 feet from thence to the town, and 12 feet up the west branch of the dock to the bridge. The walls and quays to a certain extent about the lock are the property of the dock company; the wharfs higher up from the lock are private property: the private quays are freehold, and the proprietors are not bound to keep them in repair.

Parties are subject to a penalty for allowing bricks, &c., to fall into the dock: the remedy is by summary proceedings before the magistrates. The company were bound to make the dock a certain depth at first, but not compellable to keep it that depth. The lock has required great repair. There have been 1500*l.* laid out within the last ten years on the lock itself, which sum was paid out of the annual income. There was a bond debt of 12,000*l.*; but it is no longer a debt on the company, provision being made for payment by the new Act, and it will be paid off shortly. The lock can be sluiced effectually. The outfall is cleaned out by a machine of the company's.

The tide flows at the dock-gates about two hours after first flood. A great quantity of weeds are cut in the country, and forced down into the navigation, and take much clearing out. Occasionally, the want of a supply of fresh water has been felt; in summer the decrease in height has been sometimes two feet. There is a probability of water being supplied from other sources; but so great a want of water has not been experienced as to cause water to be obtained from the Humber. There is no doubt but a sufficient supply of water can be obtained for the proposed new works.

JOSEPH LAMMING.—Has been acquainted with the port about forty years. Has been harbour-master and assistant twenty-five years. There have been no changes in the approaches to Grimsby Outfall since he has known it. Was present when the haven was cleansed in 1826; the mud had accumulated six feet in the basin, and three feet in the upper part. Three hundred hands were employed six months in cleaning out the dock; the mud was laid on the sides, and afterwards made into bricks. Six feet of mud had accumulated in twenty-six years. No foundation or brick quays gave way when the dock was cleaned out: the dock was made deeper than originally.

The second time the dock was cleaned out was with a dredger, which was hired: the dredger, I think, was about thirty or forty horse power. The dredger filled ten lighters of thirty tons each per day; the hiring of the dredger and expenses of taking out the mud cost 700*l.* or 800*l.* The greater part of the mud was laid on the banks of the river; some of the lighters were emptied into the Humber, the mud being dropped at the entrance of the outfall and sluiced away. The depth of mud taken out was three feet in the upper part; it had accumulated principally from the upland water; believes the increase of accumulation has been occasioned principally from the drainage of the neighbourhood and floods of rain. The outfall is constantly scoured out at dead low water, spring tides. Before the present dock and works were made, vessels of five or six feet could only get up at the highest tides. In the present dock, has known ships drawing eighteen feet water afloat; and about five or six years since, ships of 600 tons burthen came into the dock. There is no particular difficulty in opening the gates; three or four large ships have been taken in at a tide; they are always penned through, but if a level were made, nine or ten could be taken in at once.

The length at the present lock is 150 feet at the top; the width of the entrance and the sill is about 37 feet; the rise of the tide, about 18 feet on the average, at the gates, at spring tides; the sill is 4 feet above low water, springs; both sills are the same level. The dock-gates were repaired in 1826, and also in 1835. No doubt but part of the last accumulation was from the Humber, but the greater part came from the neighbouring up-land. If there was a reservoir made about half a mile up the drains, the mud would accumulate there instead of coming down into the dock. For the last seven years there has been no scarcity of water; the gates leaked for some time previous; salt water was obliged to be taken in from the Humber to supply the loss of fresh water.

The timber wharfs are some of them out of repair, but only those that are private property; the dock quays are in good order. I act under Mr. Brooks's direction, and he would report if any of the dock company's property was out of repair. The Custom-House quay is only a very moderate one, but it does not belong to the company. There are sufficient and proper mooring posts. To my knowledge there is no ballast thrown overboard in the dock. If I knew it was done, I should stop it.

The principal trade at this port is from the Baltic, in timber, deals, tar, seed, bones, iron, and formerly fruit. Part coal is brought to Grimsby, and part fish is also landed here; several fishing vessels come to Grimsby; they lay in the outfall and creeks. Ships driven from their anchors, or having broken their chains, frequently come into the dock for shelter. Remembers half a score ships putting into Grimsby about two years since in distress, most of them dismasted; they had been riding about the Hale Sand, and got damaged there; there was sufficient shelter for them in Grimsby. There are ship-yards, blacksmiths' shops, and blockmakers in Grimsby, to supply the shipping. Vessels can procure fresh water from a spring at the lock: they can get to it with boats, and it might be run into ships lying alongside the spring. The

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worst wind for Grimsby dock is N.N.E.; it causes large tides. The present dock has been a great advantage to the trade of the town, but I consider a lock lower down the outfall is much wanted. I have seen Mr. Rendel's plan of the proposed new dock and improvements, and I think it is much wanted; but I think, within the lock there ought to be a smaller lock, to make a level without loss of water. I consider there ought to be two pair of flood-gates besides two pair of ebb-gates.

WILLIAM SMITH, Esq., land agent, West Rasen.—The increase of accumulation in the dock by the upland drains, between the first and second cleansings, would be occasioned by the extensive under-draining then first generally made by the agriculturists of this part of the country.

ROBERT DREWRY.—I am a pilot belonging to the port of Grimsby, and have been so for twenty-two years. There are five pilots at Grimsby, licensed by the Trinity-house at Hull. We have a smack which cruizes out of the Humber: a ship boarded at Flambro' Head is taken, according to her destination, to Boston, Lynn, or Grimsby. The Humber is well lighted and buoyed, and I consider it a port of refuge, and quite safe; vessels can run into the Humber at any time, as a port of refuge; the loaded colliers generally come in with southwardly winds, light colliers with northerly winds. I have seen 300 loaded ships in the Humber at once; they would not have shelter in Burlington Bay; in winter very few masters of vessels anchor in Burlington Bay; it is considered very dangerous. I have collected the buoyage from 300 ships riding in the Hawk at one time; what is called the Hawk Roads is below Clea Ness. I only collect what is due to the Trinity-house at Hull; the buoyage is very moderate, and would not deter vessels from coming into the Humber. Many colliers come into the Humber when they cannot weather Flambro' Head; light vessels might run to Boston Deeps, but not ships with cargoes; they come to Grimsby. If a fleet of colliers sailing north could not weather Flambro' Head, they must run into the Humber. The Humber is not at all dangerous for a stranger to come to. Ships coming from the southward, when they get hold of the Sandhale Flat, might always come in by the lead. I should have no hesitation in taking charge of vessels in a storm, without anchors and cables, and running them on the soft mud. I have known vessels come to Grimsby from Lynn Roads for shelter in distress, when the wind has blown S.W. Has not known any shipwrecks near Grimsby; a great many vessels, with E.N.E. winds, run into Grimsby in distress, having lost their masts and anchors in Yarmouth Roads and Burlington Bay: if not sufficient water to run into Grimsby Outfall, ships can safely and without danger run upon the soft mud at the entrance. Grimsby Roads are the best anchorage in the Humber; the soil is blue clay, and a ship may lay there with the wind at any point of the compass. The Burcom Sands are good shelter when the wind N.E. Never knew any danger in Grimsby Roads in my life, with the wind at any quarter, and a stranger in distress might always run into the Humber, if clear weather, without an anchor. There is no other harbour of refuge near at hand; none nearer than the Thames to the southward, and the Frith of Forth to the north. The Bull Sand, now it is lighted and buoyed, is not dangerous. I think a breakwater would be an advantage. The Bull Sand ebbs and flows in height; the light is in shoal water. I have known the light-vessel break adrift. I know Patrington Creek; it is filling up fast. I think the tide might be coaxed down between the Burcom and the shore, and the weight of the tide would have more effect than any dredging. I think a turnwater on the Sunkspit Sand would have no effect.

Clea Ness is a great breakwater in southwardly winds for the Grimsby Roads, and a great protection to the Outfall, and I think it should not be touched. The wind from the N.N.W. causes the highest sea, but it is never so heavy as to prevent the dock-gates from being opened. I once knew the coping stones of the dry dock carried off by a tide when the wind was N.N.W. I think the present contemplated works, if carried out, will cause a stronger run of water, and deepen the channel. I do not think that dredging any part off Clea Ness would alter the set of the tide, because the first half hour of flood tide sets round Clea Ness into Grimsby Roads, south-west towards Grimsby Outfall, then sets to the north-west, and in that direction up the Humber. I have not seen Mr. Rendel's plans for the new dock, &c. I should prefer the entrance to the new dock being from the E.N.E. rather than from E.; do not think the tide would run too much across it, if in an E.N.E. direction; think the straighter the cutting is made from the gates of the intended new lock into the Humber, in an E.N.E. direction, the better it would be and the sooner deep water would be reached. Would prefer taking the harbour with a vessel across the tide rather than altogether with it: when going across the tide, could sheer the vessel either way; but when going before the wind and tide, the vessel would be liable to get too much way, and thus do damage to the works. Do not think that sluicing the mud out of Grimsby harbour tended to increase the deposit on the sands in the Humber, because the mud was always sluiced out at dead low water, and the flood tide, coming in directly afterwards, brought it back again upon the mud foreshore, near the harbour. Do not think that dredging below Stallingbro' would cause the ebb tide to flow straighter past the intended new works, thinks the weight of the tide would have more influence than either. If the projected works were carried out to low water, there would be a good run of water, and no fear of their silting up.

I think there is no fear of the proposed works injuring Spurn Point; there is no danger of it setting the tide stronger on Spurn, and washing away that point. The low light at Spurn has been washed down since I remember; the east side of Spurn Point wastes more than any other. There is a great quantity of shingle carried away from Spurn Point; I have seen 14 vessels laid on at a time for that purpose, averaging 50 or 60 tons each; this has been going on for the last 30 years, to my knowledge: it is used for the highways; a certain sum per vessel load is paid to the lord of the manor. I have known the Inner Binks laid up at some tides six feet, and at other tides as much washed away. I remember, about 37 years since, walking from the high light-house at Spurn to high water mark, on the east side; it was then about half a mile distant, and now it is not more than 200 fathoms. I have known 80 or 90 sail of fishermen in the Humber at one time. When I was young a fishing vessel was seldom seen in the Humber.

The principal fishing grounds are Dimlington Bank, or Inner Ground, about 24 miles from Spurn; the Silver Pits, about 30 miles from Spurn; and, about five hours' sail from Grimsby, there is also the Dogger Bank, which is the most extensive fishery in the North Sea. The fishermen principally take their fish to Hull, a distance of 18 miles further up the Humber. If there was a railroad from Grimsby, fish might, on some occasions, be in London by it before they could get to Hull: there is twelve hours' difference, at certain times, between landing the fish at Grimsby and Hull. There is no other port I am acquainted with so convenient as Grimsby for fishermen landing fish; but fishing smacks don't come to Grimsby, but go to Hull, to enable them to get their fish to the market sooner. I have not known more than two or three constant traders in fish at Grimsby, and, for want of internal communication, they have deserted the port. More fishing vessels have gone to Hull since the railway was opened there; I should say ten to one more. A great many oysters are sent from Cleathorpes and Grimsby to Hull, to go into the interior: these would go by Grimsby if there was a railroad. I know Waiofleet Haven; there is not water there at times for a four-oared boat. I have been in Wainfleet Harbour once, and never mean to go there again. I had nearly lost my life; the vessel I was in only drew six feet water, but the tide having shifted the buoys, we got to one side of the haven, and were nearly capsized. I consider Wainfleet Harbour a very dangerous place. There are life-boats at Spurn, Bridlington, Hornsea, and Scarborough; there is one on the Lincolnshire coast, at Donna Nook, which has been the means of saving many lives. It is my opinion that traffic and trade will follow the increase of accommodation for ships.

JOSEPH CROFT.—Has been acquainted with the port 37 years; has been at sea upwards of 40 years. No extra dues have ever been charged on foreign vessels at Grimsby, although the dock company are entitled to charge double dues. Has no doubt but the proposed works will increase the trade of Grimsby. The charges at Hull are near one half higher than at Grimsby; thinks the lower the dues are, the more likely will be the increase of traffic.

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Evidence taken on the 22nd Oct., 1845.

There are about 1400 vessels of about 50 or 60 tons each, in a year, carrying away shingle from Spurn Point; part gravel is laid up there with E.N.E. winds. Sir Clifford Constable, the lord of the manor, charges a guinea for every vessel carrying 60 tons of gravel from Spurn Point. Ballast for ships at Grimsby is taken from the shore in front of the Ropery; it is chiefly sand.

I have run into the Humber, in gales, hundreds of times; there is no danger in doing so. It is a good harbour of refuge, and there is no other nearer than the Frith of Forth in the one direction, and the Thames in the other. I have seen large convoys here in time of war; as many as five or six hundred ships for the Baltic. Ships coming from the Baltic for London sometimes try to make Flambro' Head in winter, but generally make for Smith's Knowl. The North Sea is well lighted and buoyed. Ships coming from the Baltic, and making Flambro' Head, would make for the Humber for shelter in a storm.

Has been in the fishing trade; there is fishing ground all the way from Scarborough to Yarmouth; used to take the fish to Hull and to Yarmouth; if there had been inland communication from Grimsby to the markets, would have brought it to Grimsby. There will be a great increase in the fishing trade when there is a railway at Grimsby; I know there would be two or three hundred sail come as soon as ever it was opened. Wilks and muscles would be found for bait for the fishermen near at hand. The fishermen who fish on the Dogger Bank get their bait near London. If more dock accommodation was given, there would be a great increase of traffic at this port. There is now a superabundance of trade in the Humber, more than there is accommodation for. Considers Grimsby the best place for landing fish on the east coast: the vessels might come in and land their fish on the flood, and get away the next ebb. Considers the Humber, in case of war, unprotected. There used to be a small battery at Spurn Point, and in case of a war, a battery there would reach vessels across. Clea Ness Cliff would be the next nearest place for a battery; but Clea Ness would defend Grimsby better, and would be the best place to put a battery on Thinks that if the Humber had been a French port during the last war, the English would have got all their vessels.

No. 223.

Rendel, on the best means of Improving the Port.

No. 223.

Report by J. M. RENDEL, *Esq., C.E., on the best means of Improving the Port of Grimsby, and Estimate.*

8, *Great George Street, Westminster,*
7th August, 1844.

MY LORDS AND GENTLEMEN,

At the instance of Mr. Babb, your clerk, I in October last, inspected your dock and haven, and the approach to them from the Humber. I have since had a survey of the same made by Mr. Knox, a competent marine surveyor, and Mr. Smith, civil engineer of Brigg, has superintended sundry other investigations, including borings which I deemed necessary to enable me to comply fully with your directions, viz., to design such an addition to your present dock, as would offer the fullest accommodation that the locality admits of for the largest class of steam vessels and merchant shipping, so as to make Grimsby a suitable port for the important manufacturing districts proposed to be connected with it by means of several railways.

The accompanying design is the result of due consideration of all the circumstances of the case, and will, I believe, be found in practice to carrying out efficiently the object you have in view. The principle upon which it based is the opposite of that observed in the formation of the present works, for these are constructed landward of high water, whilst the design now submitted extends out to low water, close upon which the entrance locks are proposed to be built, and beyond which the basin is projected.

In a river, such as the Humber, it is of the first importance that the entrance works of docks or basins should be so placed as to secure the full scour of the flood and ebb-tides. Any scouring-water applied for a short duration of tide time, such for instance as is resorted to for keeping open the present channel to the docks, is of too limited a nature to maintain a capacity and depth of channel necessary for an approach to docks adapted to the class of vessels you desire to accommodate.

In a river less loaded with silt, and in localities more favourable for applying powerful artificial scouring means much may be effected, but here I can see no security for obtaining the all-important object in view, except that of carrying the works over the whole extent of foreshore to low water, in the way shown in the design.

The proposed works include an area of 132 acres of the present foreshore, immediately eastward of the entrance to the Old Docks. This space is appropriated as follows: water area of docks, 27 acres; wharfage and round the docks 20 acres, and the remainder, or 85 acres, would be reclaimed, and would be particularly suitable for every sort of establishment which the commerce and trade consequent on the formation of a dock of this kind give rise to.

The length of dock wharfage would be upwards of 5,000 feet, and the frontage to the river would be upwards of 5,500 feet exclusive of the tidal basin. This basin is 11 acres area, the east pier being 550 feet long and the west 650, each to be found with slips and stairs suitable for steamers and other shipping not requiring to enter the dock.

Between the basin and the dock two communications are proposed, viz., one lock of suitable dimensions for passing the largest class of steamers, and the other of smaller dimensions adapted for the use of a smaller class of vessels. These two locks will, it is manifest, be sufficient for the accommodation of the trade of the new and old docks many years to come; but if otherwise, the present lock can be resorted to, both for the new dock and the old, through the proposed channel of communication which is shown upon the drawing.

This proposed cut is not only to be used as a passage for shipping, but as also the means of supplying the new dock with fresh water from the present dock. This fresh water supply for these works is of the utmost consequence, being almost free from earthly deposits as proved by experience in the present works, the large item in the usual disbursements for dredging is almost wholly saved, and the new docks will have the same advantage by excluding the tide as in the case of the present one. This, though it involves the necessity for locking vessels into and out of the docks in all cases, is an important advantage in the further respect that it adds to the value of the accommodation which the dock will afford to all coppered vessels; tending, as it will, to cleanse their bottoms, and in addition it will afford the necessary means of cleansing the boilers of steam vessels.

Off the proposed basin, the breadth of the river (at low water) is about 2¼ miles. The "Inner Roads" extend from the basin to Burcom Sands, a width of ¾ of a mile, and form the immediate approach to the proposed works. At low water spring tides the depth of water in these roads does not exceed 8 to 9 feet off the basin, but the depth increases to 5 and 6 fathoms in "Grimsby Roads," which lie E.S.E. from the basin.

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The depth in these last-named roads is about the same as that in the main channel of the river, which is separated from the "Inner Roads" by Burcom Bank.

This bank is formed of strong sands, is solid and firm, and, from the best inquiries, it appears that it does not shift. It is most important to the present port of Grimsby, affording, as it does, shelter, and acting as a turn-water for throwing the ebb tide down the "Inner Roads;" which would, but for this bank, be deprived of a sufficient current of tide to maintain even its present depth.

The borings made by Mr. Smith in these "Inner Roads," and on "Burcom Bank," show that the bed of the former is composed of soft silty matter, deposited by the river to a depth of 20 feet on its natural bed: which is a strong clay, identical in character and position with the bottom north of Burcom Bank, where the current of the river has been sufficient to prevent a deposit of silt, and to maintain deep water.

To increase the tidal current through the "Inner Roads" is, unquestionably, the most certain and obvious means of increasing the depth of water. A trifling increase would, doubtless, be sufficient to bring back a depth of 2 to 2½ fathoms, in the part where the increased stream operated with the greatest effect. This would, evidently, be at, and immediately opposite, the proposed basin, where the works project farthest into the river, and contract the width of the "Inner Roads" to the greatest extent.

That the full benefit of the increased current may be made available to the maintaining of the depth of the basin itself, I propose its piers to be built of open piled work, which, though close enough to break the force of a sea, so as to give shelter to vessels in it, should leave the whole area of the basin freely exposed to the stream of flood and ebb tides. More shelter than is absolutely necessary in a basin of this kind and upon such a river as the Humber, is inviting the annoyances of deposits; and I have therefore considered, in preparing the design, that it is easier to add shelter, if found to be necessary, than to remove the evils where more is given than is required.

In the plans and sections, I have assumed that by the projection of the works alone, we shall be able to maintain a depth of 12 to 13 feet in the basin at low-water spring-tides. This would give 18 to 19 feet at quarter flood of all tides; so that the largest class steamers, or merchant ships, could lie safely in the basin from a quarter flood to three-quarter ebb of spring-tides, and at all times during neap-tides. The silts of the new locks I should propose to lay so that vessels of every class might pass to and from the docks at half-tides.

Works such as those described, would make Great Grimsby a port superior to any on this coast for all classes of shipping. Its greatest defect would be the want of more water and shelter in the "Inner Roads;" and to obtain this advantage, it would, I conceive, be only necessary to aid nature by building on Burcom Bank, so as to raise it above high water, extend it eastward to opposite the proposed basin, and give that form which would cause the ebb and flood-tide to flow with greater velocity and uniformity along this part of the Lincolnshire shore.

The increase of current which the breakwater, shown on the accompanying plan, would produce, would, beyond all doubt in my mind, be sufficient to remove the greater part, if not the whole of the silty deposit before referred to, as forming the present bed of the "Inner Roads;' and thus make a depth of 3½ to 4 fathoms of water, where there is now only from 8 to 9 feet, and a complete high-water shelter, in place of the partial shelter afforded by the present bank.

I have well-considered the effects which these works would have on the estuary generally, and on the shores contiguous in particular, and I am of opinion that injury of no kind can arise. The river here is much too wide to be at all damaged by the projection of the docks to low-water, either in regard to any change in the strength or direction of the tidal currents; the breakwater would convert what is now at high-water a dangerous shoal to an island raised above high-water, and lighted at each end; it would throw the ebb-tide along the Lincolnshire shore straighter than it now runs, and prevent the further growth of Clea Ness Point N.E.-ward, if it did not much reduce it. It would also doubtless have a tendency to lessen the force of the tide upon Spurn Point, which is a matter of importance to all ships navigating the Humber, or taking shelter in the Hawk Roads.

As to the probable effect of the works on the entrance channel of the present dock, it is to be remarked that the wall of the new docks on its eastern side, will give increased facilities for cleaning the channel; whilst the resort of steamers and other vessels to this wall as a tide wharf, will cause an increased disturbance of water, and aid in the displacement of silt that would otherwise probable accumulate. Therefore, though there may be an increase of shelter along the line of the present channel, and from that circumstance an increased amount of deposit, yet causes of disturbance and means of increasing the present scouring power, will be added more than equivalent.

In designing these works, my efforts have been directed to lay the foundation of a great commercial port on the Humber; an object, which all who are acquainted with the growing importance of the trade with the north of Europe, and especially of the steam-boat traffic with the Baltic, will fully appreciate. But whilst I have formed the design on the large scale referred to, it admits of progressive execution in a manner that makes each step in the completion a benefit equal to its cost. For the first stage, it will I think, be sufficient to form the tide basin and locks with seven acres of the new docks, immediately within the locks; a canal of seventy feet in width from thence to the shore, on the line of the remainder of the docks, the communication with the present dock, the wharf wall along the line of the present entrance channel, and the embankment from the basin.

These works would lay the foundation of the entire plan, would afford all the requisite accommodation for an adequate trade to meet the cost of the projected railway, and would give ample scope for the investment of private capital in the necessary establishment for the accommodation of such trade.

I have obtained from Mr. Smith and other sources, the cost of materials and of works of a similar description in this locality, and am of opinion that the works above renumerated, may be executed in the most secure and complete manner, for a sum not exceeding 300,000*l.*, and that the entire of the works shown on the plans, including the breakwater, may be executed for the further sum of 200,000*l.*

If it shall be determined to bring the measure before Parliament, a necessary preparatory step will be to lay the plans and this Report before the Lords Commissioners of the Admiralty, and I would also suggest the propriety of sending copies at the same time, to Her Majesty's Commissioners of Woods, &c., for their sanction to the enclosing of the mudlands as forming the site of the works. Looking to the importance of the measure, I am quite sure both these public Boards will well consider it, and that should they agree with me in the opinion that no injury can arise therefrom to the estuary, the plan will meet with their approval.

I have &c.,

J. M. RENDEL.

To the Great Grimsby Dock and Haven Company.

APPENDIX B.

GRIMSBY.

No. 223.
Rendel, on the best Means of Improving the Harbour.

GREAT GRIMSBY DOCKS.

General Estimate.

Earthwork, 1,200,000 cubic yards, at 1*s*. 4*d*.	..	£80,000
Wharf wall, by old passage	..	37,700
End retaining wall of the tide Basin	..	9,930
Wing Piers of tide Basin, 1320 feet, at 14*l*. 8*s*.	..	19,000
Entrance Locks.		
Coffer dams	£9,160	
Great Lock	62,032	
Small Lock	35,346	
		106,538
Dock walls	..	45,725
Channel up to old Dock.		
Walls (1900 feet)	£21,280	
Hollow quoins; pair of Gates; Bridge	8,000	
		29,280
Culvert, 606 feet run, at £5		3,000
		£331,173
Contingencies, 10 per cent.		33,117
		£364,290
Breakwater, with contingencies		58,586
	Total	£422,876

LYNN.

No. 224.
Walker and Mylne, on the Eau Brink Drainage.

No. 224.

LYNN HARBOUR.

Report by Messrs. WALKER and MYLNE, *on the Eau-Brink Drainage.*

GENTLEMEN,

London, 21*st May*, 1825.

In answering the questions proposed for our consideration, on the part of the Bedford Level Corporation and the Eau-Brink Commissioners of Drainage, by the resolutions of the 4th of March last, we shall avoid, as far as we can consistently, a repetition of the observations made in our preliminary report of the 25th of March; to which therefore we beg also to refer you, our recent surveys and measurements not having detected any errors of importance in the general remarks we then made.

To prevent confusion, we will follow the course pointed out to us by the order of the questions; the first, and, as we conceive, the most pressing question at present, is—

"To what extent Lynn Harbour is deteriorated by the operations of the cut?"

The papers in our possession afford what we conceive to be accurate data for ascertaining this point. They consist of a number of detailed sections across the harbour, taken apparently with great care by Mr. Grantham, under the direction of the late Mr. Rennie, in 1820, expressly, as Mr. Rennie's report states, for the purpose of ascertaining the nature and extent of the effect of the cut upon the harbour. (The cut was opened on the 1st July, 1821) We have also a series of sections taken by the same engineer, and we presume for the same purpose, in 1819. As the sections of 1819 and 1820 vary considerably from each other, in many places more than they do from the sections of 1825, taken in April last by Mr. Vignoles, under our direction, we accompany this report by a series of sections, showing in one view the state of the harbour in 1819, 1820, and 1825; and also a Table, exhibiting the widths at low water, and the areas of the sections below that level, in the three years above referred to.

As the importance of the subject may excuse the detail, we shall now state some of the principal results; and to prevent error, we beg to premise that in our measurements and remarks upon Lynn Harbour we have taken the bottom of the Lynn tide-index as low water, and the 20-feet mark upon the same index as high water. The former soundings and sections have had reference to those two levels, and therefore we have followed them. It is, however, proper to notice, that this low water, or zero point, is that of a low spring tide in dry weather; that the low water of ordinary spring tides is from 6 to 12 inches, and that of neap tides two feet above it, when the level is not affected by rains; and also that the high water of an ordinary spring tide is three feet, and that of a neap tide eight feet, under the 20-feet mark.

SECTION III.

The sections taken in 1819 and 1820 are more numerous than those of 1825. More time would have been required to do all, but we apprehend that a full and fair comparison will be had from what we have taken.

The first section which we have compared is immediately below the junction of the new cut with the old river, across to the Marshland farm-house: the line is marked No. 3 upon the large plan of the harbour.

	Yards.
At this place the width at low water in 1820 was	66
In 1825 it was	160
Being an increase of	94

	Feet.
In 1820, the greatest depth at low water was	4½
In 1825, it was	10½
Being an increase of	6

And the depth generally under low water is increased in proportion.

	Feet.
In 1820, the area of the river under low water was	625
In 1825, it was	2450
Being an increase of	1825

Here, therefore, the navigable part of the river is widened and deepened. On referring to the section, it will be seen that the flat or sand on the west side is considerably silted up since the opening of the cut; but as this was above low water, the alteration can, we presume, in no way affect the harbour or navigation.

SECTION IV.

The point of the next section, No. 4, is from about half way between the mouth of the cut and the Boal wharf across to the same point as the last.

	Yards.
In 1820, the low-water width was	66
In 1825	110
Being an increase in width of	44
	Feet.
In 1820, the greatest depth at low water was	5
In 1825	11
Being an increase of	6

And the depth generally under low water is increased.

	Feet.
In 1820, the area of the river under low water was	692
In 1825	1798
The increased area therefore is	1106

The sand bank on the west side has increased in the same manner as in the last section, but the change is equally unimportant to navigation and to the harbour. A reference to the section of 1819 at this point shows a great decrease of depth from 1819 to 1820, the former being much nearer the present form and depth than that of 1820. This proves beyond a doubt the shifting nature of the sands in the harbour previous to the formation of the cut.

SECTION VI.

Our next section (No. 6 upon the plan) is at the south end of the Boal wharf, which may be called the upper end of the present harbour.

	Yards.
In 1820, the low-water width here was	97
In 1825	108
Being an increase of	11
	Feet.
The greatest depth under low water in 1820 was	11½
And in 1825	9½
Being a decrease of	2½
The low-water area in 1820 was	2183
And in 1825	1710
Being a decrease of	473

But as another proof of the truth of the shifting nature of the sand, it is worthy of remark, that in 1819 the area was only 1156 feet, being 554 less than the area of 1825.

In the previous sections, the distance between the shore and deep water has not increased, but in this one the evil complained of commences, the low-water line now meeting the slope of the river bank 12 yards further from the wharf than in 1820. In 1820 ships could lie nearly close to the low-water mark; now they must keep 12 yards further off. In 1820 as well as 1825, the deepest water was farther from the wharf than in 1819.

SECTION VIII.

The north end of the Boal wharf is the point of the next section (No. 8 on the plan).

	Yards.
In 1820 the low-water width at this place was 237 yards, but of this 110 yards was a flat, with about one foot of water upon it. The useful width was therefore only	127
The present width is	140
Giving an increase of	13
	Feet.
In 1820, the greatest depth was	6½
In 1825	9½
The depth is therefore increased	3
This area under low water in 1820 was	1675
And in 1825	2630
The increase of the area is therefore	955

All these alterations at this place are in favour of the cut, but unfortunately the distance from the low-water point to the shore has increased from 18 yards to 58 yards, being an inconvenience to the loading and unloading of vessels.

SECTION IX.

The next section (No. 9), taken from the most projecting point of Bagge's wharf, exhibits the evil to the private premises in the greatest extent. In 1820, the low-water line met the slope of the bank at 22 yards from the wharf. In 1825, it was 77 yards from it; so that including the differences of the angle of the slope, a vessel must lie from 60 to 70 yards farther off the wharf in 1825 than in 1820, in order to be water-borne

	Yards.
The width of the river at low water in 1820 was 335 yards; but of this 265 yards was a flat, with only one foot of water upon it; the useful width therefore was only	70
In 1825, the low-water width was 250 yards, of which 50 yards is covered with not more than two feet of water, leaving the useful width therefore	200
So that the increase of width which at low water could assist in bearing up a vessel is	130

APPENDIX B.

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No. 224.

Walker and Mylne, on the Eau-Brink Drainage.

	Feet.
In 1820, the greatest depth of low water was	6
And in 1825	8
Being an increase of	2
The low-water area in 1820 was	1741
But in 1825, it was	3708
Being an increase of	1967

And at this place an improvement in another way has taken place, by the removal of a shoal, which in 1820 extended from the Pool, or ships' berths, nearly across the harbour. In 1819, this shoal divided the river into two channels, one was on the east, and the other on the west side; but in 1820, the west channel was silted up.

If the changes since the opening of the cut are to be ascribed to its operations, we find at this place an injury of considerable magnitude, as respects the convenience of ships lying near the warehouse; but an improvement of no small consequence as regards the extent and depths of the berths themselves, and of the navigable part of harbour.

SECTION X.

Our next section (No. 10) is taken opposite the centre of Croome's warehouses. Here there is the same cause of complaint as in the last, for in 1820 the low-water point was only 28 yards from the warehouses, while in 1825 our section shows it removed to 92 yards; so that vessels must, to be supported, lie 64 yards farther off. But here, also, the navigable part is improved, for beginning at the eastern shore, there was in 1820 a width of low water of 56 yards; then came a shoal, which was dry at low water, of the width of 58 yards; this was followed by a flat with only 18 inches depth of water at low water, 83 yards wide; and then came the western channel, 124 yards. The useful width (taken in the sense we have before used the term) was therefore 180 yards, and this in two spaces divided by the shoal. Now, in 1825, there appears to be one width of 240 yards under the low-water lines in nearly the middle of the river, so that the width altogether has increased 60 yards, but the improvement to the harbour and to the navigation is in a still greater proportion.

The greatest depth in the pool was, in 1820, 4 feet, and in the western channel 4½ feet; while, in 1825, the greatest depth was increased 3½ feet, and the increase of depth for the whole width under low water is in proportion.

A corresponding increase has taken place in the area under low water.

	Feet.
For, in 1820, the pool and the western channel together were . .	1744
While, in 1825, the area in one width had increased to . . .	3678
Being an increase of	1934

Or more than double the area of 1820.

SECTION XII.

The next section (No. 12) is taken from the south angle of a projection in Mr. Guy's warehouse.

	Yards.
In 1820 we find here the distance between the warehouse and low water only	40
But in 1825, it is removed 110 yards farther, making the distance . .	150

which must, as in the last section, increase the inconvenience and expense of loading and unloading, unless the ship be laid so as to be dry at low water. But it is proper to notice here, that in contrasting the section of 1819 with the present state, the evil caused since the opening of the cut appears much less than in contrasting it with the section of 1820; for, in 1819, there was a depth of only 18 inches at low water in the pool, and that for a width of only 60 yards, so that as regards straining, a ship in so low a tide was much the same as if she lay dry.

	Feet.
The area under the low-water line in 1820 was	4474
And in 1825	5057
Being an increase of . . .	583

So that there does not appear here so much public advantage as in the other sections to compensate for the private evil.

We cannot but observe how much the navigable channel here is obstructed by the wreck of a vessel which lies in the deepest water, and is stated by the pilots to have lain there for 10 or 12 years. We cannot see what great difficulty there could have been in removing this; and if so, this great nuisance having been left there so long is no proof of a very zealous attention to the interests of the harbour.

SECTION XIV.

The next section (No. 14) is taken from the Dolphin Pile, opposite the angle of the warehouses on the south side of Purfleet. Here the distances from the warehouses to low water in 1820 and 1825 are nearly the same; but in 1820 a small vessel might have lain dry at low water upon a more even keel than now, and in neap tides she would have been water-borne in a small degree at low water.

The width of this water-way is somewhat increased, but the depth and area are decreased, so that, as regards this section, there is, besides the private inconvenience referred to, rather more to find fault with than to give credit for, as regards the effects of the cut.

SECTION XVI.

The next section (No. 16) which was taken is from the south-west angle of Mr. Stockdale's wharf.

Here the distance from the wharf to low water was nearly the same in 1825 as in 1819; but in 1820 it was about 30 feet further from the wharf. The shoal which appears to have existed opposite the wharfs in 1819 and 1820 is now removed, so that in this place there appears no cause for complaint from the owners of the water-side property. As respects the navigable part, the general depth in 1819 is considerably greater than in 1820, and this again is greater than in 1825, excepting near the west shore, where there is a small increase, but not equal to the decrease; so that, upon the whole, we should say that the balance in this section is against the cut, chiefly by the decrease of depth at high water at the wharf adding to the difficulty and shortness of time of vessels approaching it.

SECTION XIX.

Section (No. 19) is taken from the south projection of the common staith across in the line of the ferry.

In 1820 the distance from the wharf to low water was 66 yards, which was succeeded by a flat surface, with one foot at low water, extending to the present low water, which is 126 yards from the wharf; but this flat and the space as far as the foot of the staith is now converted into an inclined plane, which at the wharf is 6 or 7 feet above low water, and is therefore very inconvenient for the boats with the ferry passengers. Vessels also frequenting the common staith sustain an injury by the difficulty in getting to and from it.

There is also a small alteration in the navigable channel; the depth for 60 or 70 yards on the eastern side being decreased 3 or 4 feet, and the western side for about 30 yards being deepened about 2 feet; but the areas of the channel in 1820 and 1825 are nearly the same.

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SECTION XXIII.

The last cross section taken at Lynn (No. 23) is from the old fort or pilot's wharf, which may be said to be below the harbour.

By this it appears that the lower water widths of 1819, 1820, and 1825 are nearly the same, but the depth has considerably increased since 1820; the space, however, between the channel and the wharf, called the Long Sand (inside which, many years since, was the navigable channel), has silted up from 4 to 5 feet. This accumulation is stated, and we believe with good reason, to be an inconvenience to small vessels and boats, by preventing their getting to and from the wharfs by this channel; and although, from the change of direction caused by the cut, this evil is, in some measure at least, attributable to the cut, it is fair to state that this channel appears, from former surveys and accounts, as well as from comparing the sections of 1819 and 1820, to have been gradually silting up.

Having now gone through all the sections of the harbour which we have taken, we would beg to observe generally, that as regards the extent of the navigable or deepest part of the river, the harbour has been improved since the opening of the cut, and that the removal of the shoal is important and beneficial, but that vessels cannot approach so near the wharfs and warehouses as before, to the extent we have detailed, and thus far there is a serious private inconvenience to the owners of this property. There is another view in some degree connected with this, which is worthy of attention: although the vessels, when at their moorings, lie further from the warehouses, they certainly lie easier now than before, from the additional depth, and more particularly from being in quieter water. For it appears, from accounts which we have no reason to doubt, that before the opening of the cut the great velocity near the wharfs, during land floods, strained the vessels at their moorings, and drifted the sand from under them towards their sterns, so as to be productive of occasional inconvenience and loss. It has been stated to us as nothing extraordinary to see a vessel aground by the stern upon a sand-bank, raised up in one tide by the current under her, while by the head she was afloat, and so much so that the water was quite up to the level of her deck.

The evidence taken before the Committee of the House of Commons, previous to the passing of the first Eau Brink Act, contains such proof, from various witnesses, of the frequent damage sustained by ships in the harbour, that it is only necessary to contrast what is therein stated with the present condition of ships, to come to a decision on this point. But even if the owners of the warehouses are also the owners of the ships, there will be some difficulty in persuading them to balance the advantages against the injury. It is probably, however, no great exaggeration to say, that if, before the opening of the cut, the pool had been as we now find it, and that the operations of the cut had been to change it from the supposed state to what it really was previous to the opening of the cut, the complaints from the ship-owners of the port of the injury to the harbour and to their shipping would have been as loud as they now are from the owners of premises ashore. By the Act there is, we apprehend, no doubt of the owners of the property injured having the right to call upon the Commissioners to remove the evil: and the best and cheapest way in every case of this kind is to feel and to show a readiness to attend to it, and to do what is proper; and if the owners of the property see this, we cannot suppose them to be so unreasonable as to press the Commissioners to any extravagant and hurried measures.

As respects the west bank or shore, which, under the Act 53 Geo. III., is required to be secured at the expense of the Commissioners, our attention was not so particularly drawn to it when we were in the country. On reference to the sections we find that, since the opening of the cut, an accumulation has taken place in front of the bank, as far north as between West Lynn Church and the Ferry, and that northward of this point the bank has rather washed, but the slope appears to remain nearly the same, and we therefore apprehend that but little injury in this quarter is to be ascribed to the cut.

Your second question to us is—

> "Whether the navigable channel to sea is not improved by the operations of the cut?"

To enable us to form a judgment upon this point we have had soundings taken in the deepest part of the navigable channel, from the lower end of the cut to Nottingham Point, being the extent downwards taken by Mr. Rennie in 1819 and 1820. The section (marked E) in the accompanying book of levels and sections contains these soundings, and also the former soundings; so that that paper exhibits in one view the state of the channel in 1819, 1820, and 1825. By reference to it it will be seen that the depths of 1819 are generally greater than those of 1820, but that those of 1825 are almost all greater than all the others, excepting for a length of about a quarter of a mile above Nottingham Point, where the depths of 1825 are less than those of 1819 or 1820. We apprehend that this sudden and partial rise is owing to some temporary deposition, or other cause, or to the shifting of the channel; for we believe that at or near this point the direction of the channel becomes variable. We confess that we cannot account for it otherwise, and shall be glad when we have the opportunity of having the soundings taken again, and if found correct, the cause ascertained more minutely.

We have already stated that the navigable channel opposite the town is improved, and that this improvement consists not only, nor even so much, from the increase of depth as from the greater straightness and uniformity of the channel, by the removal of the shoal in front of the town, and by bringing into one the whole of the water, which was formerly divided into two parts, with the shoals between them. These are the natural effects of the cut, by the substitution of a straight course for the ebb of the tide in place of the former crooked one, which must have produced unequal velocities, and consequently eddies, frequent shiftings, and irregular depths.

Disinterested pilots and captains of ships are the most competent persons to speak as to the comparative facility of the channel to the sea, below the point to which the soundings taken by Mr. Grantham and Mr. Vignolles have extended. The impression upon our mind is, that the entrance to the river below our sections has been improved since the opening of the cut, but we must at the same time state that this impression is derived chiefly from the testimony of others.

The difference between the directions of the current of the old channel and of the cut is not such as to occasion any serious alterations below Nottingham Point; any change caused by the operations of the Commissioners must therefore be from the difference of quantity or velocity at the time of low water. Now this quantity has unquestionably increased, for it is allowed on all sides that the water in the river up to, and even above Denver Sluice, ebbs lower than it did before the formation of the cut. As this additional area is to be filled and emptied at every tide, a greater quantity of water must in the same time pass into and from the sea through the channel, and the consequence of this must have been the same in the entrance to the harbour as in the harbour itself. The diminution of the quantity of water passing the harbour, caused by the shortening the length of the channel, is not important when compared with the additional depth. But this increased scour, though considerable in the river and in most parts of the harbour, becomes less important in its effects as we get below the harbour into the greater area. All that we can with safety say is, that wherever its effects are felt they must have been beneficial to the entrance, and we apprehend this to be sufficient to acquit the cut.

The two following questions may be embraced into one, viz.:—

> "Supposing the cut to be widened, what is the extent and expense of works which can be required for Lynn Harbour and bank and navigation, under the Acts 35th Geo. II., c. 18, and 58 Geo. III., c. 23?

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And whether by altering the outfall of the Nar, by constructing jetties, or by any other and what means, the injury complained of to Lynn Harbour can be remedied without having recourse to any ulterior works beyond the provisions contained in 58 Geo. III., c. 23, and the several clauses in 59 Geo. III., relating to Lynn ?"

If by the first of these questions it is meant to include our opinion of the extent and manner in which the cut ought to be widened, we beg to state that it is not so much the absolute quantity that is important, as an increase at the proper time, to form an addition to that velocity which causes the effective scour in the harbour. An increase at high water would not, for this reason, produce any important effect; the tide in the river above the cut would scarcely rise any higher, and at low water it would sink no lower than it now does, either in the cut or above it, nor would it produce any additional scour of any consequence in the harbour.

The most useful increase would, we think, be got by widening the cut from the top to the bottom of the navigable part, making the slopes as great as consistently with stability they can be, and to let the form of the bottom be nearly a straight line, so as to increase the low-water section, for the very sufficient reasons stated by Mr. Telford. An increase (formed in this way) of about one-third the present area, would produce a very considerable effect by lowering the water in the cut, and in the river to a great distance above it, thus increasing the quantity and the scour near the time of low water. As regards the extent and expense of any other works in addition to the enlargement of the cut, we think it very difficult to give an opinion worthy your attention until the effects of widening the cut, completely stopping up the old channel, and giving the current from the cut the proper set upon the harbour, be ascertained.

The present deposit in front of the warehouses, which we consider the principal or only evil complained of, will be removed by a small additional scour, given in the proper direction; and the first and most natural way of doing that appears to us to be by the measures we have referred to.

As the direction of the current is of greater consequence than any effect to be expected from any additional quantity, we are of opinion that after the present embankment across the old channel is completed, no time should be lost in making another embankment outside the present one, to form a fair line between West Lynn and the mouth of the cut, in the direction originally intended, in order to confine the current from spreading over the sands, as it now does.

Thus, the execution of the works we have described, and the determining their effects, will be the work of some time, and unless means be taken to prevent it, the temporary inconvenience will continue arising, not so much from the distance between the ships' berths and the warehouses, as from the muddy shore at low water, and there being no fixed way to load and unload when the tide is up. Should not something be done to remedy this? The erection of temporary gangways or platforms upon piles, between the ships and the principal warehouses, appears to us the cheapest and readiest way to meet this evil, and the expense of these, when compared with the great works which we have seen mentioned for removing the cause of the complaint, would be small. The Lynn merchants would thus see that their interests were being attended to, and would not be disposed to lead the country into hurried expensive measures, until the effect of those which are in contemplation as part of the present plan be ascertained.

There may be objections on account of the craft or otherwise to the plan we have hinted at, or the expense may be greater than we contemplate. We are sure, however, that the evil will not appear greater by its being attended to, while the application of the remedy will be more pleasant to all parties, and more reasonable to the one upon which the expense may fall.

For the reasons we have stated, we would recommend that any alterations in the outfall of the Nar be at least delayed.

Your next inquiry is—

> "Whether the drainage of Marshland, as provided by the 19th section of the first Eau Brink Act, is not properly effected by means of the new drain and sluice at the upper end of the cut, and if not, whether it will not be effected by the widening the cut, without the new drain mentioned in the 20th section?"

The former of these works, viz., the drain and sluice at the upper end of the cut, called Marshland Sluice, is excellent; the drain is good in all respects, and of great capacity, the sill of the sluice being two feet two inches below one of the sills of Knight's Goole, and three feet two inches below that of the other. The operation of the cut has also been to lower the water in the river opposite Marshland, about three feet below what it was before the formation of the cut. It is natural to expect, therefore, that all the district which drains in this direction will be more effectually provided for now than before the opening of the cut, and the information we have collected confirms this conclusion. When we last viewed this place in April, the water was so effectually drained by the new sluice, that although the old sluice (Knight's Goole) had been entirely closed for a long time, the water was drawn from the drain close to it by the operation of the new sluice, so that it was as low then as it had ever been seen during 20 years previous to the opening of the cut, in the very driest season. If this was the case close to the old sluice, it must have been still lower in all the country between the old and new sluice; and this too, although the full operation of the new drain was prevented by a temporary stank near its head, which kept the water dammed up from 12 to 18 inches at that time. It is superfluous after this to multiply words in proof of the improvement in the drainage of this part of Marshland. This position may appear at variance with the fact, that upon either one or two occasions since the opening of the cut, during very heavy floods, the gates of the new sluice did not open for three days; and that in consequence, Knight's Goole was opened and continued to discharge the water for some days, while the new sluice-gates were shut. This variation from what we have stated is in appearance only. The new sluice-gates were kept shut at the time by the water in the river being at a greater height than the water in the drain. Knight's Goole Sluice opened because it had not this pressure upon it, the course of the river having been changed into the new cut. Without such a cause, Knight's Goole Sluice opening while Marshland Sluice remained shut would have been little less than miraculous. Had the same flood taken place before the opening of the cut, it is evident that all the outlets near this place would have remained shut longer than the new Marshland Sluice did, inasmuch as the effect of the new cut has been to lower the water in the river, and to discharge the floods in a shorter time than the old course did. Our opinion of the drainage of the part of Marshland, north of Tilney Goole, is not so favourable. The sill of West Lynn Sluice appears to us to be too high: our levels make it three feet higher than Tilney Goole, and only 14 inches under Glenchwarton Goole. The point of discharge of West Lynn Sluice gives very great advantages over the old gooles which communicate with the old river, and which were liable to be choked up by the shifting channel, but we must at the same time say, that full advantage has not been taken of the new site, and that we see nothing to have prevented West Lynn Sluice being as low, or nearly as low, as Tilney. In our preliminary report, we remarked that the drain leading from Tilney to West Lynn was much neglected, and the passage of the waters much obstructed; in proof of which, we noticed a foot passage having been formed across the drain, by havins and sods thrown in; which had the appearance of having remained there a considerable time. Indeed, there is no doubt that even with the present outlet, the drainage is capable of great improvement. But as in this country good drainage is so very important, we think there has been a mistake in placing the sill of this sluice so high, and that even now the error should be rectified, if on examination, it is found to be the means of obstructing the drainage.

The words in the question "properly drained" are, we conceive, to be construed with reference to the state of drainage before and since the opening of the cut; and in this comparative sense, we consider Marshland properly drained, without the new drain mentioned in the 20th section; and that when the

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works we have referred to in the cut, and in the West Lynn Sluice, are completed, an essential improvement of the drainage of Marshland will be the consequence of the works done under the Eau Brink Acts.

Since writing the above, we have referred to a document in our possession, dated March, 1820, signed by the late Mr. Rennie and by Mr. Telford, being a section to regulate the levels of the intended West Lynn drain and sluice. We there find the intended sill shown 14 inches only above the sill of Tilney Goole, which would have given the capability of nearly two feet additional of drainage. The bottom of the drain is in the same section shown four feet above the sluice.

The question that follows is as to—

"What effect the new drain mentioned in the 20th section would have upon Lynn Harbour?"

Presuming that the drain is to commence near the head of Marshland Sluice, and to be carried round to West Lynn, so as to convey a portion of the water which now passes through the Marshland drain and the cut to a point, which, as it regards its effects, may be said to be below the harbour, we reply, that in proportion to the quantity thus diverted the effect must be injurious. As regards the use of the proposed drain in other respects, it appears to us that if the outlet of Marshland Sluice is large enough, the utility expected from the new drain must arise from the water being discharged at a place where the loss of level between Lynn and the upper end of the cut is avoided. The difference of level between Marshland Sluice and the Free Bridge at the time our levels were taken was 15 inches at a neap, and two feet eight inches at a spring tide, low water; the weather was then dry for the season. In flood times it is of course more; and upon one occasion it appears from the register to have risen to the extraordinary difference of seven feet five inches, as stated by Mr. Telford; but when the cut is enlarged the fall will be lessened, and in calculating the effects of this new drain upon the country south of Tilney, the fall in the surface of the water in the drain itself is to be deducted from the fall of the cut. We apprehend that the balance is by no means such as to justify the expense, and we certainly think that to "properly drain" Marshland, in the sense we have taken it, this new drain is not required.

We are next asked as to—

"The expense of making the necessary alterations in West Lynn drain and sluice?"

More detailed measurements and surveys than we have been able to make would have been necessary, to enable us to state a sum. If the cost of Lynn drain and sluice are known, we should think that from one-third to one-half of the original cost will fully cover the expense of the alterations.

The two following questions have reference to—

"The improvements we may think requisite in Denver Sluice, and the works which may be necessary above the sluice (to protect navigation) in consequence of such improvements."

Our reply to these, as to all similar questions, is, that estimating will require more detail of survey and measurement than we have been called to bestow upon the subject. That the whole of the works of, and connected with, Denver Sluice, are in excellent condition; all we believe having been repaired, and a considerable part improved and renewed within a few years, according to the plans of the late Mr. Rennie, approved by Mr. Telford; and no doubt under the best consideration, which, from their intimate and particular knowledge of the subject, these eminent engineers were able to bestow upon it.

In a report, dated 1822, by Mr. Telford, and the present Mr. John Rennie, we find the only alteration proposed in Denver Sluice to be the lowering of the sills of the sluice. They recommend this from the expectation, that if the water at the top of the cut be lowered, the same additional depth will extend all the way to Denver Sluice, and that if the sluice sills were lowered, the whole of the South Fens would be enabled to lower their drains. The lowering of the water so high as Denver Sluice, to the extent here calculated upon, is of course upon the supposition, that the whole of the bed of the river, between the cut and Denver Sluice, will be deepened and increased, and that the low-water area for the whole length will be as great after the water is lowered at the upper end of the cut as it now is. Until this be the case, the additional depth obtained at Marshland Sluice will decrease upwards. In ordinary and dry weather, the fall through the cut is, as we have observed, only 15 inches at present, which is not greater than the average fall up to Denver Sluice. Now, as no alteration of level will take place at or below Lynn, any lowering of the water so high as Denver Sluice in dry seasons can be produced advantageously only by a general increase of the area of the river, rendering a less slope and velocity throughout necessary; but as the enlargement of the section to this extent, and the lowering of the sill of Denver Sluice, will be a work of considerable time, or very great expense, or both, we should be inclined to advise some experience of the effects of enlarging the cut, previous to any important alteration in the river above it, or at Denver Sluice. The banks of the river between Denver and the cut do not appear to be such as to render any considerable increase of the area prudent, until they are strengthened or set back. The safety of the adjoining levels requires the previous consideration of this question, for we think that the present section of the river enlarged, as it has been, by the operations up the cut, is as great as is consistent with the stability of its banks, many of which are already so bad, and so badly constructed, from the very erroneous way of each owner repairing his own small piece to his own taste and science, that we are surprised the breaches in them are not more frequent than they are. An argument in favour of proceeding cautiously in works of this nature is afforded by the circumstance that the works of Denver Sluice, so lately improved and repaired, are now recommended to be altered, in such a way as to make it desirable, if the recommendation be adopted, that the repairs had not been made.

Messrs. Telford and Rennie's report does not appear to recommend the lowering as an immediate measure; we agree with them that the lowering of the sill would be an improvement, and tend to produce the effects they describe, but the expense of the work would be very serious.

The next question is perhaps the most weighty of the whole. We are asked—

"What effect the removal of Denver Sluice will have on the lands in the South Level, and what additional banks and works will be required in consequence of such removal?"

We shall be brief in our reply.

Our opinion is, that the removal of Denver Sluice will have the effect of raising the water in the rivers above the sluice in dry weather to nearly the same horizontal level as the tide at Lynn, and in times of flood to a considerably higher level, increasing upwards; and that the banks of the rivers into which the tide is to flow, should, to be safe, be of the same height as the bank of the Hundred-foot river, or nearly so, after the materials are consolidated, and the seat of the bank fixed; as we believe that the Hundred-foot bank is not found too high, we see no reason for the others being lower, for the greater indraught of tide, caused by opening the rivers for its reception, will increase its velocity, and in the end enlarge the channels to meet the additional demand, so as to give a supply to the same level it now does.

Those who are acquainted more intimately than we are with the various stages in the history of the river, will, we apprehend, find that by every enlargement of the river and removal of obstructions, the tides in the interior have come nearer to their level at sea, even in dry seasons. The accounts we have are recent, but go to prove this position. A register has been taken of every day's tides from the 1st to the 24th July, 1821, just before the opening of the cut (31st July, 1821). We find by this, that the tide at Lynn rose during all those observations about one foot higher than at Denver. This difference was, in a great measure, caused by the circuitous irregular passage and the shallowness of the old river. Another register, taken in

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December, 1821, when there may be supposed to have been some land-water, makes the tide higher at Denver than at Lynn to the extent, for a few of the tides, of two feet, and on the average, one foot. A printed account for every day in December, 1821, agrees with the above. Mr. Vignoles's observations in April, 1825, after some weeks of dry weather, makes the high water at Lynn and at Denver Sluice upon the same horizontal level. We may therefore conclude that, in the present formation of the river, the accelerating and retarding forces balance each other, and that when there is no flood-water, the tides at Lynn and at Denver rise to the same level; but that in winter, when the water is swelled up by the meeting of the flood and the tidal water they rise considerably higher at Denver.

Now, as the deepening of the river both below and above Denver Sluice will be the consequence of the removal of the sluice, we do not think there can be a difference of opinion as to the necessity of embanking to the level we have proposed.

Mr. Dyson, the surveyor for the Bedford Level Corporation, has made a very detailed survey and estimate of the expense of raising the banks, and constructing the other works which he considers requisite above Denver, in consequence of the removal of the sluice, and from his great experience and accuracy he is well qualified for the task. His estimate is upwards of 700,000*l.*

Mr. Vignoles has proved Mr. Dyson's principal levels to be correct, and we have ourselves dissected some of the leading items of his estimate. He has made his banks rather smaller, and one foot lower, than we have here advised, and, upon the whole, we think his estimate very moderate. He has not included the works which will be required for navigation.

In dry seasons the low-water level above Denver Sluice will be lowered by the removal of the sluice, because there will be no means of keeping up the water; but the pen by the gates of the sluice is now kept up only when it is required for the benefit of navigation. In times of flood the gates are thrown open, to allow the flood-water to pass off, and the sluice-keeper informed us that he has never seen more than a few inches fall through the sluice. If this be so, the sluice, even in its present state, cannot much impede the drainage.

If the river below the sluice be deepened, then it would be useful to lower the sill; and if it is so narrow as to prevent materially the free passage of the water, it ought to be widened, so that, as regards the capability of drainage, every obstruction may be removed; but the entire removal of the sluice at Denver does not appear necessary for effecting these objects, and if the sluice can be shown to be otherwise useful, it is better not to remove it. Is it, then, otherwise useful?

In the mass of important matters, and the very short time since the surveys made under our direction have been completed, we may advance opinions which a better judgment may lead us to correct, but at present our opinion (without at all considering the expense of embanking, and other measures required for the future defence of the levels) is, that the existence of a sluice or pound-lock at Denver is beneficial, by retaining the water for the navigation in dry seasons; that by keeping back the tide-water it assists the artificial or mill-drainage from the fens into the river during the winter, and forms a security to the south levels in case of a breach in the banks of the river above the sluice. Of these the first is perhaps the most important use At present the navigation is stated to require the water in summer to be kept up to the level of seven feet six inches upon the navigation sill; the low-water level in the river in very dry summers is, we were informed, sometimes as low as the sill During the whole of the dry summer of 1823 there was never more than three feet of water upon it. The low water on the 12th of April last, when we viewed it, was three feet six inches upon the sill; now, it appears very doubtful to us, if the effect of admitting the tide will ever be such as to deepen the bed of the rivers above the sluice, so as to give a natural depth for navigation equal to the present pen, for we find the present improved depth in the river below Denver Sluice less than this, even after it has been joined by the Hundred Foot River; and we cannot think that the Ouse alone will be likely to produce so great a depth, because if the sluice operates as a low-waters tank only to the extent of a few inches (as the keeper stated), the low-water scour cannot be much increased by admitting the tide, nor its effects in deepening the bed of the river very important.

Supposing the sluice to be removed, we are next asked—

> "What works the Navigation Commissioners will have to construct in the Hundred Foot and South Level rivers beyond what they would have if they were only improved under the Act 59 Geo. III., and the expense of such works?"

As respects the Hundred Foot River, we cannot see any effect of consequence which the removal of Denver Sluice is likely to produce; we presume the question to have been put to us under the idea that a proportion of the tidal water which at present scours the Hundred Foot River, is likely to be diverted up the South River. This evil, if it be felt, will, as we have explained, be only temporary, as every tide and flood will assist in scouring the river below the Hundred Foot, until the section be increased and the equilibrium restored.

At present, during the high floods, the waters which come down the Hundred Foot River overtop the water from the South River, and keep the gates of Denver Sluice shut until the water is discharged; the Hundred Foot waters have then the entire possession of the river below the sluice for their exclusive use. After the removal of Denver Sluice this would not be so. The tide would flow and ebb in the Ouse also, and share the use of the river below at every tide. So far, the floods which come down the Hundred Foot will take a somewhat longer time to get off until the river below is enlarged, so as to be equal to the discharge of both in the same period.

As the natural deepening of the channel above Denver Sluice, contemplated as the effect of its removal, would, at the least, be a work of time, artificial means by dredging must, we suppose, be employed, to give depth of water for the barges. Part of this may perhaps be applicable for raising the banks; but if it is not, the expense of the work resumed for navigation only will be very great. Mr. Dyson's opinion is, that the soil near the Ouse, and other south rivers to be embanked, is all moor log, and therefore unfit for forming a bank, and that the soil must be barged from a distance.

The question next in order is—

> "What will be the expense of completing the lower dam across the old deserted channel of the Ouse?"

For the reasons already stated, we are not prepared to give an accurate estimate of the expense of completing the dam. This can be ascertained by a measurement of quantity from a detailed plan, and knowing whence the material to form it is to be taken.

It would be desirable in point of economy, and for the purpose of forwarding the completion of the works and determining their effects, if the soil which is to be removed by barges were taken first to raise the embankment for the Wisbeach road, which crosses the old channel, and after that is completed, and some stanks formed across the site of the present current in the old channel to assist their silting up, it might be time to proceed with the principal embankments, so that the full effects of the abstraction of the water in the old channel, which now assists the scour of the harbour, and the effects of the change of direction, may be ascertained. The site of the old channel is already considerably above the marsh which it adjoins; the part towards the upper end is above the level of an ordinary tide. As the dam at the lower end will be formed with less difficulty if the embankment of the Wisbeach road be done first, so that the tide may be excluded entirely from above it, we think it advisable to adopt this course in the execution of the work.

The last question in the instructions we first received is—

> "Whether the contraction of the channel below Lynn, as provided for in the Bill, is a work necessary for the preservation of the harbour and navigation from injury arising from the operation of the cut within the contemplation of 35th Geo. III., sec. 18?"

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Our report having already extended to too great a length, we shall answer this question by a short monosyllable, "No;" and we beg to refer you to our reply to your second question for our reasons for this opinion.

The additional question which has come to us by way of rider to the instructions, is—

> "Whether the cut, as now executed, corresponds with Captain Huddart's award, and is executed in compliance with the contract made with Messrs. Jolliffe and Banks, and if not, that we do state the differences thereof."

Having examined Captain Huddart's award, and Messrs. Jolliffe and Banks' contract, and had a number of cross sections taken of the present state of the cut, we beg leave to report generally, that, so far as we can discover, the contract is framed according to the award, and the work executed according to the contract.

One of the principal data for ascertaining this is the point from which Captain Huddart went, as the level of the 12 feet 9 inches tide, to which all his sections refer. We have not been able to find that point, but we conclude that it was well known at the time, and that the work was set out and executed in compliance with it.

Some question having arisen as to whether the excavated earth should have been laid upon the forelands, as has been done, or wheeled over the banks, we have been particular in examining the award and the contract as to this, and find that both contemplated the forelands being raised with it; the surface of the foreland nearest the navigable cut level with a 12 feet 9 inches tide, and that next the bank with a 15 feet 9 inches tide. The contract contains a clause that the banks will have to be raised higher in some places than stated in Captain Huddart's award, that they may contain the surplus earth; so that any want of compliance with the award as to levels would not be to be charged to the contractors.

The contractors were to complete the dam across the deserted channel at the lower end of the cut. This has not, as you know, been completed; but as they were paid at a price per 400 cubic feet, and not a sum for the whole work, they have of course been paid only for what they have executed.

Until we perused the contract, the forelands appeared to us to have been left in a very unfinished state; and, even with the explanation which the contract affords, we can by no means praise them for the opposite qualities. It is but justice, however, to the contractors to state, that the contract directs them to lay out part of the excavated earth as spoil to be conveyed afterwards to form the dams at the end of the cut, and the present irregularity in the surface may be caused in part by the soil intended for the lower embankment still remaining upon the forelands, which the contractors might have thought better not to remove until after they should finally dress off their work.

The longitudinal section of the east foreland (marked K), which accompanies this Report, is taken half way between the foot of the bank and the edge of the navigable cut, and shows that a good deal of levelling and dressing are requisite to finish the surface of the foreland in proper and workmanlike manner.

We are, &c.,

J. WALKER,
WILLIAM SHADWELL MYLNE.

To the Honourable the Corporation of the Bedford Level,
and Commissioners of Eau-Brink Drainage.

To the Committee of Commissioners of the Eau-Brink Drainage.

London, 10*th June*, 1825.

GENTLEMEN,

Having given the matters referred to us all the consideration which the time allowed for our preliminary report has enabled us to do, we beg to premise our answers to your questions, with this remark, viz., that the foundation of our opinion is the general survey which we have made, and the various surveys and measurements previously taken, with which we have been favoured. We have no reason to doubt the correctness of these measurements, but reserve the right of correcting any errors which a more mature consideration and the completion of the surveys now making under our direction may enable us to discover.

You inquire—first, "our opinion as to the necessity for widening the cut beyond the extent of Captain Huddart's award."

Our reply is, that such widening, though not in the strict sense of the word necessary, is at the least expedient, if the cut as now executed is agreeable to Captain Huddart's award—whether it is so, is one of the points referred to us for our future report; assuming, however, for the present that it is so, the Eau-Brink cut presents us, at its upper end (according to Mr. Telford's sections), with a river suddenly contracted to half its area; and at the junction of the lower end of the cut with the old course, it suddenly swells out again to more than twice the section of the part immediately above it. This appears to us unnatural, injurious, and inconsistent with a state of permanency. As one of the principal objects of the cut was to improve the drainage, the area of its section at the upper end should not, we think, have been less than that of the old river, of which it was to form the continuation; and its area should have increased in proper proportion towards its lower end, so as to have some correspondence with the area of the river into which it was to be discharged. We think it probable that this increase may be obtained by excavating the forelands and altering the shape of the navigable part of the cut without extending the space between the banks; but our detailed survey will enable us to decide this with greater correctness than we can at present.

The second question is,—"How far the widening of the cut is a necessary measure to remove the evil complained of as to Lynn Harbour, and the drainage of Marshland." We do not consider that there exists anything like an absolute necessity for widening the cut, as regards either the drainage of Marshland or Lynn Harbour, although we think that it is required for more important objects; and that an improvement to Marshland as well as some benefit to Lynn Harbour will be the consequence. As to the first of these objects, the impression upon our minds from the information we have received, and from the greater depth and excellent state of the new Marshland drain, is, that the drainage of Marshland is already much benefited by the works done under the Eau-Brink Acts, excepting during extreme floods: and our own observation of the very neglected and foul state of the drains, particularly to the northward of Tilney Goole, enables us to say that the present means of drainage are by no means used to the extent of which they are capable. In recommending as we do, upon general principles, the widening of the cut, we think it our duty to notice that which we conceive to be one of the effects which will result from it, and which we think therefore requires attention and caution; we refer to the further deepening and widening of the channel of the river between Denver Sluice and the cut. Our observation as we walked along the banks was, that the scouring already caused by the new cut, is, in some places, quite as great as is consistent with the stability of the banks; and as any extension of the cut will increase the scour and further weaken them, we think it advisable that these be carefully surveyed and strengthened where necessary, before the cut be further widened.

In reply to the third question, viz.,—"How far the widening the cut is necessary as a preliminary to other works, and whether the necessity of it is immediately pressing as regards Lynn Harbour," we beg to say, that the widening of the cut and clearing and deepening the interior drains, to communicate with the present leading drains and outlets, may be considered not as a preliminary, but as the only measure likely to

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be required to effect the object of sufficiently improving the drainage of Marshland. By widening the cut, the water in it opposite the Marshland Sluice will be considerably lowered at every low water, and the tidal waters will pass off more rapidly; thus both increasing the time of discharge of the Marshland Sluice, and the quantity discharged in any given time. As respects Lynn Harbour, we assume that the injury which it has sustained consists in the accumulation of sand opposite the town, chiefly above the ferry; and that the channel of the harbour has deepened and improved since the cut was opened. Parties thus injured on the one hand and benefited on the other, are very apt to confine their observations to one side of the question—to represent or magnify the injury done, without allowing the benefit received to be balanced against it. In the present case there appears no doubt that the berths for ships have since the opening of the cut been thrown at a greater distance from the warehouses; that some inconvenience and labour must be consequent upon this, and that it is the duty of the parties who have probably caused this evil to take means for removing it. Nor do we apprehend much difficulty in accomplishing this. A small increase of velocity upon the east shore of the harbour at the proper time of tide is the only thing requisite. There are several ways of producing it, and if this were the only object to be accomplished, we should be disposed in place of recommending the widening of the cut, to effect the object by giving the present current the proper direction, which, as regards the ships' berths, we do not think it has at this time; and that this at all events be tried before any means, by jetties or otherwise, be employed; for unless caution be observed here also, another and certainly a more serious evil may be produced by too great a scour, not only endangering the foundations of the buildings, but throwing too strong a current against the ships while at their berths. The evil, as at present felt, does not appear to us of so pressing a nature as to call for any extensive hurried operation to remove it; but we again repeat that the different effects of widening the cut are, in our opinion, such as that it ought not to be unnecessarily delayed, and the more particularly as the old channel of the river is every day silting up; so that we apprehend in the course of a very few years the old course may be entirely stopped. As the excavation from the cut may be advantageously applied to form the embankment across the present channel, it would be desirable as regards economy, if both works could be proceeded with at the same time.

Our general opinion is, that when the new cut is widened and the old course stopped up by a bank so formed as to give the proper direction to the current, the evil now complained of by the Lynn merchants will no longer exist.

The last point upon which our preliminary report is requested is, "Whether the confining the navigable channel of the Ouse from Lynn Harbour to the sea is a necessary measure for restoring and protecting the harbour." As we find it generally agreed that since the opening of the Eau-Brink, the channel of the harbour and the entrance to it from the sea have improved, we consider this question still to have reference to the sand bank opposite the town, and in this acceptation our opinion is that the harbour will not be restored by confining the navigable channel. The expense of such a work, taking it literally as stated in the question, would be immense; exceedingly probably in its original cost, and the expense of supporting it, more than the value and produce of all the fens drained by the river, and therefore very unnecessary and disproportioned in reference to this object. We can scarcely suppose such a measure to have been seriously contemplated. There is, however, no doubt, but that the navigable channel would be deepened and improved by confining the width to seaward, and that the effect of such a measure would be to restore the depth, which historical record states to have been long since lost; but as this loss cannot have arisen from the formation of the cut, we do not feel ourselves called upon to notice the subject further.

We are, &c.,
J. WALKER.
WILLIAM S. MYLNE.

To the Committee of Commissioners of the Eau-Brink Drainage.

GENTLEMEN,

London, June 10, 1825.

You request our opinion of the reasonableness of the fears entertained by the owners of the banks between Denver Sluice and the Eau-Brink cut, in consequence of the alterations now going on in the Hundred Foot river.

As we have no information of the extent of those alterations, it is not in our power to give any other than a general opinion, that as every increase of the Hundred Foot river adds to the quantity of the tide water which passes up and down the river below the Hundred Foot, and that as by enabling the flood waters to come down the Hundred Foot more rapidly, it has also the effect of increasing the scour in the river during times of floods, the effect is to deepen the river and to increase the friction upon the banks.

Unless, however, a considerable increase be intended in the Hundred Foot river, the extent of these natural effects will not be such as to excite any well-grounded alarm in the minds of the owners of the banks.

We are, &c.,
J. WALKER.
WILLIAM SHADWELL MYLNE.

Appendix B.

Wells.

No. 225.

No. 225.

PORT OF WELLS, NORFOLK.

Examining Commissioner—Joseph Hume, Esq., M.P.

Evidence taken on the 29th October, 1845.

The following Commissioners of Wells Harbour were present during the proceedings:—The Rev. Valentine Hill; James Chapman; John Hudson; Hugh Rump; Robinson Parker; Joseph Springall Southgate; James Young; John Hammond Parker; John Wiseman; Henry Hammond; Henry John Crofts, and Thomas Garwood.

Mr. Joseph Southgate, Harbour Commissioner, Clerk, and Treasurer, examined.—Has no maps of the harbour, nor any report amongst the Harbour Trust documents except Mr. Rendel's Report, dated the 6th Feb. 1845, a copy of which he forwarded in answer to the Address of the House of Commons of 9th August, 1844.

Mr. Thomas Garwood, Solicitor, handed in a Report made by Mr. Rendel, C.E., dated the 5th December, 1844, and stated that it was made at his instance as agent to Lord Leicester, and it related to the enclosing of the West Marshes, of an area of 580 acres; he had seen Captain Beaufort, and understood from him that the West Marshes might be reclaimed without opposition from the Admiralty, provided the Admiralty engineer reported favourably upon the project in regard to its probable effects upon the harbour; and Lord Leicester, on account of the large expense to be incurred, has not yet decided whether he will enclose these 580 acres or not, Mr. Rendel's estimate being 11,760*l*. Appendix No. 234.

Mr. Southgate stated that there were no ancient records in the Harbour Archives; they had been removed under a previous Commission, and had not since been heard of.

Mr. Garwood, Mr. Chapman, Mr. Harman, and others, informed the Commissioner that the most injurious of the embankments of tidal lands which had been made was that by Sir John Turner in 1758, across the Warham Slade; he was then Lord of the Manor, and carried it into execution against the wishes of the Harbour Commissioners. 26 years afterwards (in 1778), the harbour had so much deteriorated that the Harbour Commissioners of that time applied to Serjeant Grose to know whether the embankment could legally be removed, and he gave an opinion in which he states "*that all embankments which by preventing the flow and reflow of the tide stop up the harbour, and are prejudicial to the navigation, were nuisances at the time they were made.*" Upon this opinion, between 1779 and 1784, three trials took place in the Court of King's Bench, and two verdicts were found for the Commissioners. In the last trial the Court allowed 562*l.* for costs and expenses (which sum was paid by the representatives of Sir John Turner); and an injunction, granted by the Court of Chancery in 1781 to restrain the removal of the banks, was dissolved, and the Harbour Commissioners were declared to be at liberty to throw them down, which it appears they did, from a minute, which stated that at spring tides the sea flowed to the ancient limits of the port. Appendix No. 228.

Some time afterwards, when Thomas Wm. Coke, Esq., became possessed of the lands which formerly belonged to Sir John Turner, he made a proposal to the Commissioners, as appears from a minute on their books, dated 29th of January, 1808 (which was read to the Commissioner). Mr. Coke stated that he would erect a reservoir sufficient to contain all the water which overflowed that portion of the Marshes, and by this means the backwater would not be lost, if they would permit him to enclose the Marshes with an embankment. This proposition was acceded to, and a bank was afterwards thrown across, which impeded as effectually the flow of the tide up to Warham, as the bank erected by Sir John Turner had done. The reservoir, however, which was promised to be substituted for the embanked space, was never completed, and the backwater was not obtained; and it is now completely silted up; and thus, by this act of concession to the Lord of the Manor, with whose predecessor the Commissioners had struggled so resolutely and so successfully for many years, the waste lands and the backwater were both lost to the Port of Wells, and no corresponding advantage gained. Appendix No. 231.

Wm. Allan, examined.—States that he has been a pilot at Wells for 34 years; that at present, when it is low water, the bar is sometimes dry, and the channel has from 6 inches to 2 feet in it: the deepest water is in the pool; at high water there is from 18 to 20 feet on the bar; does not consider that any change has taken place in the depth on the bar since he has become a pilot in 1811; it is a shifting bar, and is now about a quarter of a mile to the westward of what it used to be. "The Wells Fairway Buoy," is in 7½ fathoms at high water, and 4 fathoms at low water; from that the depth in the channel at high water decreases to 15 and 14 feet until opposite the Scalp Beacon, where there is 13 feet; from the Scalp Beacon to the Pool Beacon there is from 12 to 14 feet; from the Pool Beacon there is a depth of 11 or 12 feet; at the quay there is 12 feet at high water ordinary springs, and 1 foot at low water. At ordinary springs there is about 21 feet range of tide on the bar and only 11 feet at the pier; the high water at the pier is about half an hour later than at the bar, the distance being about 2½ miles; considers that there has been more water on the bar since the East Fleet was dammed.

In 1822 there was a difficulty in getting a vessel up drawing 8 feet water, now one drawing 12 can get up to the quay; that a southerly wind is the best wind to leave the harbour with.

A vessel cannot get out with the northerly wind from E.N.E. to W.N.W.

A steam-tug will take a vessel out to sea at the rate of 2*s.* 6*d.* for each foot of her draught of water.

He could berth 50 or 60 sail in the pool and channel. The north winds bring the heaviest surf on the bar. Ships cannot come into the harbour at night.

Mr. James Chapman, Harbour Commissioner, states, that in 1818 a dam was thrown across the East Fleet: this was done with the intention that the flood and ebb should come round by the quay and so commence the scour higher up the channel: in continuation of this plan, the mouths of the smaller fleets in the east side have been closed, and the water generally brought round by the Town Quay, and the additional scour thus produced has had the desired effect of deepening the channel at the quay; the flood, also, by closing the mouths of the fleets, is thrown more directly up the harbour.

Mr. Edward Houghton, Surveyor, examined.—States that the East Marshes thus enclosed, from which the direct tidal flow is excluded by banks at the mouths of the Fleets, contain from 700 to 1000 acres, which at ordinary spring tides are covered with from 1 to 2 feet water.

Wm. Harman states that he has been a pilot since about 1805. Remembers when vessels drawing 5 or 6 feet water could go over the East Marshes where there is now only 1 or 2 feet: small vessels used frequently to go to sea out of Broadarse Channel. Knows that the large East Fleet itself is filling up, and some of the smaller ones are altogether obliterated.

APPENDIX B

WELLS.

No. 225.

Evidence taken on the 29th October, 1845.

THE COMMISSIONER inquired if there was any record in the Harbour Books respecting the erection of the dam across the East Fleet.

Mr. **JOSEPH SOUTHGATE**, referring to the Harbour Books, read a minute dated 20th February, 1818, which gave notice that a subsequent meeting would be held to take into consideration the propriety and probable effects and expense of throwing a dam across the East Fleet; and, from the Harbour Books it also appeared that the meeting so convened, on the 2nd of May succeeding, decided upon damming up the channel at an expense of 526*l.*

Mr. **CHAPMAN** states, that a dam has also been thrown across the Sluice-hole, and has improved the harbour channel by directing the ebb down it.

COMMISSIONER.—Does the enclosed large space of the East Marshes show a tendency to fill up?

Mr. **CHAPMAN** and the rest of the Harbour Commissioners.—It does; but the embankment has for the present improved the channel by directing the tide round by the quay.

COMMISSIONER.—Is there any professional man or engineer at present employed by the Commissioners to superintend the works at the quay.?

Mr. **SOUTHGATE.**—No.

COMMISSIONER.—What is the extent of the West Marshes which are proposed to be enclosed, and to what depth does the tide flow over them?

Mr. E. **HOUGHTON.**—580 acres, and at high tides covered with 3 feet of water; the general effect of the embankments is to silt up the fleets. Some parts of the Marshes that used to show large fleets, are now nearly obliterated.

Mr. **SOUTHGATE** stated, that none of the money raised from the shipping had been applied to dredging the channel.

Mr. **HOUGHTON** states, that when the tide flows 12 feet in the channel, the whole of the Eastern Marshes are covered; at all tides above that height the Marshes are over-flowed. During the tide of the 20th of October, 1845, there was a mean depth of 2½ feet on those Marshes.

Mr. **SOUTHGATE** stated, that there were three Acts for the improvement of the harbour, viz.: 10 Geo. III.; 5 Wm. IV. 1835, and 7 Vict. 1844, and then produced the account books of the Harbour Commissioners; and from his examination it appeared that, up to July, 1845, 9650*l.* had been borrowed at five per cent. interest, upon assignment of tolls; that there were 24 Commissioners who were self-elected, and that these Commissioners audited their own accounts.

Mr. **ROBINSON PARKER**, a Commissioner, complained that he had never seen the bills for stones, &c., of the quay; that there was no auditing of accounts previous to the meeting of the Commissioners; that he had been anxious to see the detailed accounts, but could not see them.

Mr. **SOUTHGATE** said that about 6000*l.* had been expended without any contract, and no professional advice had been obtained on the works. On the 18th of September, 1844, the bank account was opened; but the banker's book does not exhibit the total amount received. In 1844, 4000*l.* had been borrowed, but the banker's book only showed 600*l.* to have been received. The difference was paid away, partly by the Commissioners and partly by witness. Upon further investigation, it appeared that there was a minute on the Trust Book which made it imperative on three Commissioners to sign the cheque before any payment was made; but Mr. Southgate said that he was authorized by the Commissioners to pay and expend all that money without any such formality; it also appeared that he was the receiver of the dues.

Mr. W. **DAWSON**, the collector of customs, in reply to a question from the Commissioner, whether there was any check on the receipts, said that he had never been applied to by any of the Commissioners to compare the dues received with his book.

Mr. **ROBINSON PARKER** stated, that a private meeting of Commissioners took place in September, 1844, to which he was not summoned, and at that meeting bills were passed for the payment of 589*l.* 16*s.* 5*d.*

He also stated, that he had applied several times to see the books, but to no purpose; at one time it was alleged that they were in London, at another, that they were not in the house, &c. He admitted, however, that he had not applied to see them since the passing of the Act of the 7 Victoria.

Another Commissioner corroborated the latter part of Mr. Parker's evidence.

Mr. **CHAPMAN** stated that there was a steam tug. After it was purchased, it was placed in charge of Mr. Robinson Parker, but after that gentleman was dismissed from his situation of Harbour-Master in July last, it was given in charge to Mr. Southgate, the clerk.

The **COMMISSIONER.**—Why was it not given to Mr. Parker's successor?

Mr. **CHAPMAN.**—Because it was considered that Mr. Southgate would superintend it better.

The **COMMISSIONER** asked to see an account of the expenditure on the steam boat.

Mr. **SOUTHGATE.**—There is no separate account of the steam boat kept.

The Commissioner to Mr. Chapman.—Can you, as chairman of the Harbour Commissioners, give us no account of the expenditure of this steam boat?

Mr. **CHAPMAN.**—The account for the steam boat is mixed up with the general account.

Mr. **SOUTHGATE** further stated, that he was Collector, Treasurer, Clerk, and Commissioner; he also has charge of the steam tug, receives and pays away all the money, and superintends the execution of all works that are done.

On investigating the tonnage dues, it appeared that vessels from Blakeney paid more than vessels from any other part of England; they were charged at three-fourths of the rate on foreign vessels, because the Wells vessels were charged the same in Blakeney. It also appeared that there were nine pilots belonging to the port, recommended by the Harbour Commissioners and appointed by the Trinity Board. Each vessel drawing less than ten feet is charged one shilling and sixpence pilotage, and all larger vessels two shillings.

No. 226.

Report of Mr. John Smeaton, Engineer, *relative to the Harbour of Lynn in Norfolk.*

Austhorpe, 14th September, 1767.

Smeaton on Lynn Harbour,

The matters to be reported upon as given me in charge by the magistrates of Lynn, were principally the following:—

1st. The preservation of vessels in the harbour of Lynn, from the annoyance of winds and waves; not only from the sea, but from the broad river above the town, when the wind happens to be in that quarter, and also from the raging tides that often accompany them, and drive the vessels from their moorings.

2nd. The preservation of the banks of the river, and more especially those near the town, from the action of the winds and seas, accompanied also with too rapid a tide.

The better to enable me to acquit myself upon those subjects, I carefully examined the channel of the river Ouse, from the roads near the Ferror Beacon to German's Bridge; and also the banks thereupon, and more particularly those within two miles of the town of Lynn. I have also carefully viewed and examined the circumstances attending the said river, from German's Bridge to Denver Sluice; so far as they appeared to me to have any relation to the business before-mentioned.

In the course of these inquiries, I had the pleasure to find that the channel of the river, and particularly that part to seaward, not only from the accounts of the pilots who attended me, but from my own remarks, compared with former accounts and reports, was, at the time of those observations, viz., in the month of July, 1766, in as good condition as it had been known for many years; and, in fact, without any material cause of complaint. That a bar had formed itself in the upper mouth of the west channel, and that the current at low water was wholly confined to the east channel, which had in consequence proportionably improved.

This is, indeed, a very material change in the state of the channel and harbour for the better; the contrary condition having been complained of for years past, viz., the choking of the harbour and channel to seaward with sands, and the great tendency of the current to take the west channel instead of the east; which latter (as it seems) was that, which, according to the unanimous opinion of all those who have reported upon it, was the desirable channel to be maintained, and, if possible, improved; the doing of which has been the subject of much projection and altercation: but as nothing appears to have been done in consequence, but that nature has very kindly brought matters into a more desirable state, it seems of the utmost importance to propose nothing for execution, that shall counteract her intentions; nor while we are relieving one evil induce a greater,

According to all accounts, the point below the crutch on the east side of the river, called at present Nottingham Point, projected much further to the westward: and another point of land on the west side of the river, below North Lynn, but above the said Nottingham Point according to the course of the river, projected further eastward; so that, to a person standing upon the quay, called the Common Staith, at Lynn, the sea was land locked by these two points; but that now, by the gradual wear of one or both of them, an observer standing at the same place, will at high water see the sea considerably open between the said points, and the wind being in that or nearly that direction, that is, betwixt N.N.W. and N.N.E., and a strong spring tide of flood, the ships are apt to ride very unquiet, that lie within the point formed by the Common Staith and the Ball, which may now be reckoned the port of Lynn, and where the ships chiefly lay to be loaded and unloaded from the merchants' yards.

This evil I find has been complained of for many years; and that in the year 1741, a scheme was offered by Mr. John Rosewell, which was to build jetties from these two points, so as to produce the same land lock as formerly; and this he imagined would not only redress this immediate grievance of too much swell running into the harbour, but also another one at that time, also greatly complained of, that is, obstruction by sand, too shallow a channel, a high bar in the east channel, and too great a diversion of the current into the west channel.

That those jetties might be of some use in checking the swell of the sea, cannot be denied; but the ill effects they were likely to have by increasing the tendency of the out channel to the westward, is set forth with great justness and spirit in a small pamphlet, published in the year 1742, entitled "Some Thoughts on Mr. Rosewell's and other Schemes, now proposed for amending Lynn Channel and Harbour;"* which, as I suppose it in every one's hands, to save repetition I recommended to a re-perosal, from the beginning, to and included the ninth page. And indeed Mr. Rosewell's reasoning, if such it can be called, concerning the improvement of the east channel by means of those jetties, has not been more solidly refuted by the author above referred to, than it has since been by Nature herself; for it seems very manifest, that in proportion as the points, particularly Nottingham Point, has been worn away, the channel has tended more eastward, and has improved in proportion as the west channel has decayed, which must be expected from an union of the two forces. As therefore the maintenance of the channel out to sea, in the good condition in which I found it, I look upon as a primary consideration. I entirely agree with the author before-mentioned, that it would be a dangerous expedient to reinstate the two points above-mentioned by the building of jetties; on the contrary, I am of opinion, that were a channel must be maintained through a vast mass of sand, capable of shifting by winds, seas, currents, and every temporary impression of power thereon, that the more directly the waters make their passage out to sea the better.

Nor am I very clear, that the reinstating of the points would entirely cure the evil at present complained of, they being at too great a distance from the interior harbour, and must necessarily be placed at so considerable a distance from each other, that unless the entry was entirely spoilt, I apprehend the seas would still find the way within the heads; and in so long a fetch to the place where the ships lay, would gather and still disturb them at their moorings.

Nor can they be of much use in checking the too great indraught of the tides, at present complained of; for the passage between them must be very narrow to produce a sensible effect, and in proportion as it was contracted it would wear deeper, and thereby still admit nearly the same quantity of water to pass. Yet if they could be so made as to check the raging tides, they would check the moderate ones too; and I believe all agree, in opinion, that in the situation of Lynn Harbour, the greater the efflux, which in great measure depends upon the influx, the better channel may be expected to be maintained; too great tides may be a partial and temporary evil, but it appears to me in the present case a fault on the right side; and it seems that in this, as well as many affairs of human life, the judgment consists in choosing the least of two evils.

I cannot however agree, in recommending the expedient mentioned in the latter part of the pamphlet above quoted; that is, in damming up the old river at the west point, and cutting a new one through the land down to the road; for this, if not made equal with the mean capacity of the old river, would check the influx of the tides, and if so made, would be a most monstrous expense, and at last the event uncertain; for by producing an alteration in the set of the currents, without the mouth thereof, it perhaps is out of the power of human foresight to say with certainty, that (after so great an expense) some bar or impediment might not be thrown up, producing an equal obstruction to those then complained of; but thanks to Nature for relieving us from the necessity of so chargeable an expedient, and giving us the opportunity of knowing when we are well.

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* This pamphlet is anonymous, but I since understand was wrote by Mr. Elstobb. See Appendix.

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The simple point of view, that in my opinion is necessary to be attended to for the preservation of the channel, is to do nothing materially to affect the indraught of the tides, or to diminish the quantity of fresh waters coming down the river from above; as to the rest it must be left to nature, and though in such a multitude of acting forces and disturbing causes, the goodness of the channel must by turns become better and worse, yet the grand principles of preservation being maintained in all the vigour possible, after a wrong turn happens a right one will succeed, as experience has shown to be the case; at least, leave nature to herself while tending right, it is time enough to help her when we are sure she is going wrong.

It is observable, that the point formed by the Common Staith, and running out betwixt that and Common Staith Lane, may be considered as the jetty, whereby the ships lying above in the interior harbour, are ultimately defended from the swell coming in from the sea, and it is only the swell that gets round this point from the sea that affects the shipping; for, in fact, the ships that lie in the channel of the river between the Purfleet and the Ball, are land locked by this point. This jetty has very much the appearance as if it had been artificially carried out, as well as defended by stone wharfing for this very purpose. The river is however still a furlong, that is, 220 yards wide at this point according to the plan; the channel lies over to the opposite shore, where it is 10 or 12 feet deep at low water, whereas it gradually shallows towards the Lynn side, leaving the ground dry at low water for above a chain in breadth.

If I was obliged to recommend something in the jetty way, it would be to run out this wharf about a chain further, that is, 22 yards, being one-tenth of the whole width of the river. I am very clear that such a projection, immediately before the shipping, would afford more protection than six times as much work done at the two points below, which are at the mean distance of a mile and half, and this without being attended with any ill effect upon the channel below. The only objection that I see to this scheme is, that by narrowing the channel in this the narrowest place, it would in some measure check the influx of the tides, and throw the water more powerfully upon the opposite shore, just below the ferry, the defences of which are already too weak; but if this bank was effectually defended by a sufficient body of rubble stone, applied in such a way as I shall mention, when I come to speak upon the defence of the banks, the effect would be to scour out a channel so much deeper in this place, as by creating an equal section, would furnish the same quantity of tide water as at present, and probably might deepen the channel on the Lynn side; at least, something might be done to entice it to act in that manner.

It is observable, that at the end of Common Staith Lane, there is a considerable prominence of rubbish that has gradually been formed, and that something of the same kind has been thrown out partly from the lanes, and partly from the houses, quite away to the Purfleet and higher. I look upon it that it is owing to this body of rubbish, that the channel of the river edges over so soon to the west side; if this body of rubbish was dug away as near to the buildings as can be done with safety, and taken away down to or below low-water mark, as far down as the Common Staith; that the ebb tides, accompanied with the land floods, would improve the channel, and enable the ships to lay not only lower down but closer in, and thereby more effectually shelter them from the seas, which would be broke off by the Common Staith Point; and this is a step that I would recommend, whatever becomes of the proposition of an extension of that point.

I come now to the defence of the shipping, when the wind is at south-west or westerly; that is, when it blows right down the broad river which extends above the town, and with this view it obviously occurs, that if a jetty or breakwater was carried out upon the sands from the point above Old Lynn, this would in some degree shelter the shipping that lay from the Ball downwards: but yet, unless the jetty is extended from A to B in the plan, that is, the length of a furlong or 220 yards, the vessels laying at or near the Ball, will still be exposed almost as much as before; on the other hand, this work will throw the current more forcibly into the bite, or great hollow opposite this point, where the water sets already too hard, and is making daily depredations. I would therefore beg leave to suggest, that as no ship laying from the Ball downward, can be subject to a direct fetch of more than a mile in length; and since in this length no great swell can be raised, but only a short chopping sea or windwash, which would signify little, independent of the force of the wind and a strong tide of ebb, both which must remain; I say, I would put a query, whether it would not be advisable at once to endeavour to increase the security of the vessels in the harbour, by improving their moorings, and which I apprehend might be done by putting down a row of strong dolphins on the west side of the channel in the middle of the river, and continuing the line lower down, and increasing in number those that are on the east side. This measure, independent of every thing else, would be a great security against disturbance both from land and sea. However, if the magistrates are inclined to begin a jetty or break-water from the south-west point in or near the direction specified in the plan, in order to try the effects of it, I would not be understood to discourage the attempt; and if not carried beyond the limits there specified, I apprehend any ill effects that it might have upon the opposite bank might be guarded against. It may be begun with rice and rubble stones, and afterwards by sinking old vessels, or continued with the former materials, as shall appear in the execution best to answer the end.

I come now to the subject of the banks; and on this head, as I have already declared that my opinion is in general, to discourage all attempts to prevent the free influx and efflux of the tides and land waters, in order to preserve the channel out to sea in the most effectual manner, and upon which both the navigation and drainage dependent on the Ouse entirely hinges; there nothing remains to be done with the banks, but to make them stout enough and high enough to stand against all extremes; my business will therefore be, to show how this is to be effected. To give directions about the particular parts would be endless, and will be the proper business of the surveyor, who shall be entrusted with the execution thereof; I shall therefore content myself with showing the general principles, which will easily be applied by the judicious artist to the particular cases.

In the first place, I entirely disapprove of all jetties built into the stream, as a defence for saving the banks or foreshores from the action of the water, as I am convinced, from many observations, that they have a direct contrary tendency; for they seldom ever fail of producing a deep pit, either opposite to, or on the downstream side of the jetty which tends to undermine the banks, and even the jetty itself, so that thereby the rent is made worse.

Whatever works are attempted for the preservation of the foot of banks or foreshores, when too hard a set of the water tends to undermine them ought to be disposed parallel, or according to the direction of the stream, so that the water instead of being stopped or thrown off, shall glide gently by with the least interruption possible; for thereby the water gets away with the least possible action upon the banks, and consequently wears them or their defences the least. For this reason all angles and sudden turns are to be avoided as much as may be, and where a turn must be made, as very frequently happens, let it be made with as easy a sweep as possible, keeping it as near as may be the same with the natural, that is, the general bend of the river, cutting or rounding off all small sudden turns, angles or extuberances, which may happen in the general sweep; which directions will hold, as well for forming the base and middle lines of the artificial banks themselves, as for preserving the foot of the natural foreshores, whereon the other is founded. To act otherwise is to oppose a natural current, and to oppose a natural current is to give it something whereon it may incessantly act, towards the destruction of the opposed work; which in the case of banks and their defences, is to do something contrary to the very intent of doing it.

This doctrine cannot be better illustrated than by the two great jetties, in the turn above the Ball-fleet, opposite and just below, which are 5 and 6 fathom water; whereas the natural bottom or depth is not more than as many feet. By this means their foundations are sapped as well as the adjoining banks, and which

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in consequence must be subject to very extensive repairs, as the bite of the river will grow deeper on every alteration.

This is also the case with a number of jetties on the west side of the river below the ferry; to say the truth, I scarcely ever saw an instance where those sort of works, when applied as a defence to the banks, did not do mischief; it would be very well that they were all removed, or if this is thought too much expense, at least never more to be repaired in their present form.

Where the sides of a river or foreshores grind away by too great stress of water, the most infallible, secure, and lasting method of doing it is, after the sudden extuberances and irregularities of the curve are taken off as low as the water will admit of by hand, to line up the foot with rubble stones, thrown in promiscuously, so as to form their own natural slope against the shore, till they appear above water at low water. This being done for the whole length of the galled place, with the regularity before described, and being further supplied with a fresh quantity after a settlement has happened, in consequence of succeeding great tides and floods; will prove a lasting security against further depredations at the foot, and the foot being well secured, Nature will, in most cases, where there is room to do it, form of herself such a natural slope to neap tide high-water mark as will need no artificial defence. The chalk and clod-lime rubble that is brought down the river, seems a very good material to be employed in this way; but the rubble of any stone that will bear wet and dry will do, which can be procured cheapest; the larger and more irregular, both in point of shape and size the better.

The same defence, where stone is wanting, may be procured by the application of stakes and rice; but disposed, as before directed, even and parallel to the stream,* without jettings or extuberances; but nothing can be done with these materials comparable to rubble stones, on account both of want of weight and duration.

It may possibly be objected, that a sufficient quantity of rubble stones, to secure the foot of the banks and foreshores in this manner will be expensive, and in some cases possibly it may; but it must be considered, that here will be no expensive tide-works with a number of men, and that there will be very little additional charge beyond that of bringing down the stones; but in preference to all methods that are in themselves ineffectual, the cheapest way is to do nothing.

The base of the bank, and foreshores being secured as above described, it has already been said that where there is room enough, nature will herself form a slope upon the foreshores up to the high-water mark of neap tides, which will be of itself a sufficient defence against waves and currents; and where there is no want of room to form a sufficient slope above the neap tide high-water mark to the top of the bank, there is no better way than to slope and turf it over, in the manner that has already been put in practice, but above and below the town of Lynn, and also on the other side of the water. I can give no better directions than these specimens will afford, which seem done with great judgment; only that instead of using any wood at the foot of the turf about neap tide high-water mark, I would advise to rely wholly upon a lay of rubble stone, and if some of it is broke small, so as to fill up the interstices of the larger pieces, this will form a more complete union between the rubble and the turf, than if composed of large stones only.

Where the artificial banks stand steep upon the foreshores, I observe that the practice about Lynn has been to defend them by a boarded wharfing. This, at first, seems to promise much security; but experience has proved that this is only outside: and if we consider the action of the waves upon it, we shall find this method not at all calculated to sustain their shocks for any length of time, the very union of the part being the cause of their destruction.

If the sea dashes against the end of a faggot or a stone, these having no solid connection with their neighbours, the impression goes no further; but the tremours raised in one part of a boarded wharfing is communicated to the whole, or to a large area; which accompanied with the great shocks that must ensue when a considerable part of the surface is struck together, these agitations by little and little shake and loosen the earth behind, which by the rise and fall of the tides is by degrees washed out at the foot and through the crevices, which brings the whole to ruin. This, accompanied with the speedy decay of all wood work exposed to wet and dry, makes it seem to me quite eligible totally to discard this method in all future repairs. In lieu whereof I would recommend the following: wherever the foreshores are not broad enough from low water to neap tide high-water mark to stand by a natural slope, I would advise them to be reduced to a slope of two to one; that is, to batter 2 feet to 1 foot perpendicular; and this being covered a foot thick with rubble stone of all sizes bedded together and footed upon the rubble, supposed to be thrown in to support the ground under low-water mark, will, as I have often experienced, make a very lasting defence, and is capable of great resistance in all ordinary cases; but if exposed to the waves of the open sea, the cover must be increased in weight and thickness. This method will answer the end, if the latter is three to five, or even one to one; but the latter I would not recommend without extreme necessity.

With respect to the upper part of the bank, from the high-water mark of neap tides, to the high-water mark of the equinoctial spring tides, I would, in all cases where it is possible, shift back the banks till they will admit of the slope and turf method above referred to; but if this is not possible, to continue the same batter as the foreshore, and to face the artificial banks with stone in the same manner as already described.

I do not know of any security against inundations in a country that is defended by banks, otherwise than by making those banks, not only sufficiently strong, but high enough to sustain the greatest extremes, without being overflown; and it is from experience alone that these extremes are to be learnt. The greatest extreme of a flood or tide that has been known at Lynn, appears to have been one of the 2nd of December, 1763, when the water flowed 1 inch deep in the counting-house of Mr. Elsden of Lynn, and left a very visible mark which he showed me. This mark should at high-water of some spring tide be transferred to the Custom-house, or some public place near the river, to which recourse may constantly be had. Though this is the largest tide we know of, yet there are accounts of several tides within a few inches as high as this; I do not therefore look upon the banks in safety, unless they are proof against such another tide as this, and to this as a standard I would constantly refer; I cannot, however, look upon them as proof, unless they are made up at least 1 foot above the level of this mark, and maintained after settlements at the height of half a foot above the same. It is not, however, necessary to preserve the same slope above the high-water mark of equinoctial spring tides to the extremest height, as below that mark; because they will but seldom come to a stress; yet when they do, they must, however, be sufficient, or they answer not the end.

In order to this, they ought to be 3 feet at least broad at the extreme height, and at least three times as broad at the level of the equinoctial spring-tide mark, as the extreme height exceeds that height. The artificial banks below that mark should be at least four times as broad in their base or seat upon the natural level of the ground, as the perpendicular height of the said extreme tide mark is above the natural level of the ground, whereon each part of the said bank respectively stands. These proportions will be very sufficient in the neighbourhood of Lynn, where the earth is good; but where the earth is loose, sandy, or moory, the bases or seats and tops should be respectively broader.

These are the best methods that I know of putting the town and country in a state of security, every other attempt to lessen the tides themselves will not only be vain and fruitless, but even, if effected, hurtful to the general drainage and navigation of the country.

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* The ends outward, and a little inclining down stream.

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If the expense be objected to of making up the banks in this manner, I answer, that if we take the compass of a few years it will be a great saving; but since this is the only permanent and secure method that I know of, it is not worth the while to put the properties into a state of security, that then the proprietors must be contented to possess them in a state of insecurity.

After having declared it as my opinion, that every attempt to check the free influx and efflux of the tides (that is, while it remains an open river) is likely to be hurtful to the scour of the sea channel; it seems natural to be asked, if I do not look upon Denver Sluice in this light? I answer, that Denver Sluice is much too far up from the outfall to work any considerable effect either way; but that the natural effect of it as well as the 100 foot drain, so far as they operate on the harbour of Lynn and sea channel below, must be rather beneficial; as may be demonstrated from a circumstance mentioned in Badslade's History, page 46, where, speaking of the river Ouse, he says, "The low-water mark up the river is much lower in neap than in spring tides; whereas down to seaward, the low-water mark of a spring tide is lower than that of a neap." This being the case (which is not a peculiarity of this river), it is evident that the spring tide of flood in the remote parts, could not get back again the same tide; but, instead of returning back, spend itself up the river, and in the fens, before that sluice was built; it is therefore, at that length, more useful to check the tide of flood in order to give it a better recoil, than to suffer it to spend itself in the fens at the spring tides, and languidly to return in the neaps, without power in itself to operate, or to co-operate with such a tide as would give it power. The cause, therefore, of the universal silting of the channel of the Ouse, after the first erection of Denver Sluice, and cutting the 100 foot river, so universally and loudly complained of, must be sought from other sources, than a natural tendency of these works to produce this effect; but as this will lead me into a fresh and large field of matter, not immediately conducing to the business in hand, I shall forbear the pursuit of this subject any further at present.

I cannot conclude my report without observing, that it strikes me that the surest, and I may add the cheapest way of putting the ships into a state of perfect security, would be by building wet docks in the manner of Liverpool; for which, the situation of Lynn seems to afford a noble opportunity, particularly in the flat ground below the Blockhouse.

J. Smeaton.

No. 227.

Remarks on Mr. Rosewell's, and other proposed Improvements of Lynn Channel.

No. 227.

Extract from a Pamphlet printed in the year 1742, said to be wrote by Mr Elstobb; *intituled, "Some Thoughts on* Mr. Roswell's, *and other Schemes, now proposed for Amending Lynn Channel and Harbour;" in a Letter to the Merchants, Owners, and Masters of Ships, belonging to the said place.*

Gentleman,

The present state of your channel is now not only become the common topic of conversation, but also the laudable care of the magistracy, whose ready disposition to do service to the town, is evidently manifested by the early steps they have taken in this affair, in consequence of which Mr. Rosewell, by order of the Honourable the Commissioners of the Navy, has lately inspected the harbour and channel to seaward down as low as the road, and has proposed a method to remedy the evils, which he observed at present to attend them, and to prevent their growing bad for the future.

But as I think the remedy he proposes, will not remove the evils he complains of but will rather increase them; so I cannot forbear giving you my sentiments thereupon, though without any design of depreciating that gentleman who, I doubt not, is sufficiently judicious in things of this kind. But as he came an entire stranger to the place, and as I am informed took but a transient view of it, and formed most of his sentiments from the information of people prejudiced in favour of particular notions and opinions concerning the thing, it is not to be wondered at that he is so far wide of the matter.

His opinion it seems is, that the badness of the channel to seaward is owing to a bar of sand, lately grown up cross the east channel, about three miles below the crutch-point. And he says, he is informed, that the said crutch-point on the east, and the point on the west side of the harbour's mouth formerly land-locked each other, by which means the harbour was preserved in a great measure from the fury of the north-west winds, and flood tides, was rendered safe, and the channel maintained deep and good; but by the continual force of the fair winds and tides against the west point, and by the violent action and force of the south-west winds and ebb tides against the crutch-point on the east side, both these points of land are now much shortened, and the harbour laid more open; so that the fury of the north-west winds tears down the marches, endangers the banks, and threatens the ruin of some of the lands on the east side of the river, between the blockhouse and the crutch; the consequence of which may be (he says) the entire loss of the harbour. Besides, since the points are thus become open (I think he says), it occasions the flood to form an eddy, by which means the filth subsides, and has formed the bar which he so much complains of.

The remedy therefore which he proposes is, to erect two jetties or wooden piers, one on the west point, to stretch over to the eastward; and the other on the crutch-point, to stretch itself to the westward; and so to landlock the harbour, as it formerly has been.

By this means (says he) the harbour will be preserved from the violence of the north-west winds, and flood tides, will be rendered safe and quiet, the east channel recovered and the bar be scoured away.

This, gentlemen, is his opinion, and the remedy he proposes. And now, with all due submission, I shall beg leave to give you my sentiments thereon.

It is to be observed, that in the present state of the harbour and channel, there are but two evils which have fallen under his notice.

The first is a bar of sand on the east channel, three miles below these points, which bar he supposes to be lately grown up, and formed by means of an eddy in the flood tides, occasioned by the shortening or opening of the said points. But how the alteration of the state of these points could any way form such an eddy as to occasion a bank of sand in the channel, at three miles distance, is to me quite unconceivable. Besides, the bar is no new formed thing as he supposes, but is of old standing, as is well known to the gentlemen navigators, though it is not always in the same state, but often fluctuating and changing; being sometimes higher, sometimes lower, according as seasons have proved wet or dry, and the quantities of the ebb and back waters have been greater or less. Thus in some very wet seasons, it has been almost worn away, and the channel for a while maintained good; and in dry seasons again, it grows up, and the channel becomes bad; which has lately been the state of it, though now by the increase of the back waters, it is already much mended. However, let the duration of it, and the formation of it be as they will, the removal of it is the thing.

And this I believe every one will agree must be effected, by the ebbs and back waters, which should be conveyed as entirely unitedly, and directly to it as possible, so that they may exert their whole undiminished force and power thereon, without meeting with any stops or impediments in their way. For the force of water in scouring away a sand, or deepening a channel, is always proportional to the quantity acting in a given time, and the vigour or force with which every equal part of that quantity does act. Thus, for instance, if a tun of water was to pass over a sand in a minute's time, and every gallon of that water exercised a force on that sand, which may be represented by one or unity, then the whole force exercised in a minute's time upon that sand, may be represented or expressed by the number 252. But if the quantity of the water acting in the same time be doubled, and the force with which every gallon acts be doubled also, as it will be if the velocity of the current be doubled, then the force of the water

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xercises upon the sand in a minute's time, will be four-fold what it was before, and in this case may be expressed by the number 1008.

What then can we think of this gentleman's jetties, which instead of conveying the back waters and ebbs directly to the bar without obstruction, must necessarily divert them from it, and turn them over to the westward, giving them such a course as will direct them much more into the west channel, and cause them to strike more directly against the brest sand than at present, and so both lessen the quantity acting, and also the force with which every proportional part does act; so that if the bar increases and grows upon us now, we may then expect the decay of the east channel will be much accelerated; for sure it is not a little absurd to imagine, that turning the course of the ebb water more to the westward, can promote the removal of a sand which lies in the east channel, or any way deepen or mend that. Too much of the ebb water does already go down the west channel, which lies too directly in its present course; but if its direction be changed still more to the westward, as it certainly will be by these jetties, then the principal part of the ebb water will be turned into that channel, and other slade ways, which can afford it a passage to the westward; and the east channel will be almost deserted, and left almost dry every ebb, and consequently in a little time would choke up, and be entirely lost.

So far then is the method this gentleman proposes from being a certain remedy to the east channel, that in all probability it will be the utter destruction of it. And thus much for the first evil he complains of.

The other evil is, the washing away of the marshes, and the danger ofdrowning the lands on the east side.

This, I shall beg leave to observe, is a thing which more immediately concerns the land-owners than this corporation. The security of their estates is certainly as much their own proper concern, as the security of those on the west side is the proper concern of the owners of them. But (says this gentleman) the drowning of these lands will be the ruin of your harbour

This, I must confess, I do by no means apprehend. Suppose, that 200 or 300 acres of these lands were every tide laid under water, not one gallon the less water would flow up the river than does at this present, and all the waters which would then cover these lands in the time of flood, would be an additional quantity to return in the time of ebb, which would certainly very much help to scour away the bar, and maintain a good channel. But, suppose that the security of the harbour does depend upon the preservation of these lands, are these jetties like to be effectual for that purpose? I conceive not. It is true, they will lessen the beat of the tides during the time of high water, which by the opening of these points, when the north-west wind blows is now very great, and washes away the surface and turf of the land very fast; this, I say, would be in a great measure prevented. But then the flood tide would be carried continually and directly into the crutch-bite, and so would the ebb also, and by the continual and violent action of both, the lower shores would be ground away, and the bite extended more and more to the eastward, and the lands and banks will be as effectually ruined by the undermining of the shores, as by the wash and beat of the waters upon the surface; though, perhaps, not altogether in so short a time.

Now, as I think this will certainly be the consequence of this scheme, so I thought it an incumbent duty to apprize you of it, that you whose interests depend upon the preservation of the navigation of this port, may make proper representations against it.

I know some gentlemen are mightily alarmed at the wearing away, and opening of the two forementioned points, as if the ruin of the harbour must immediately ensue, and as if the goodness of the channel entirely depended upon the projecting or extending of these points. But it may be remembered, that some years ago, while Denver Sluice was standing, and the reception of the flood lessened, and the back waters prevented from coming down, the quantity of the ebbs was then so small, that it was all carried off by the west channel, and the east channel was so deserted, that at low water it was left almost dry, which made it soon grow so shallow, that at the time of high-water, there was not water sufficient for any loaden ships, all which were forced to go round at the back of the sands, and come through the west channel up to town; and at that time these points were both far extended, and land-locked the harbour. It is therefore very evident, that the goodness of the channel does not depend upon the extension of these points, nor do I apprehend that there is such imminent danger from the opening of them, as some are inclined to think.

The channel is now in as good a state as it commonly has been in for some years. And if we should in a little time have a continued wet season, which may happen, it will quickly be much mended. And I think it is much the better way, to trust to nature for a remedy, than to execute at a great expense such schemes, as in all probability will be very pernicious and hurtful to the channel.

Some gentlemen, it seems, do plainly discover the impropriety of Mr. Rosewell's scheme, but yet think something ought to be done for the preservation of the lands, and the amendment of the channel, and therefore are for erecting a jetty across the crutch-bite, all along the east side, towards the Blockhouse; and another jetty on the west point, to extend this point more over to the eastward.

The first certainly so long as it stands, if made sufficiently high, will be a great security to the marshes, and lands on the east side, and would prevent both flood and ebb from encroaching on that side, and likewise assist them in scouring away that pernicious point of sand, which extends itself from the west point, so far over to the eastward into the crutch-bite, for though the turf and vegetable soil at the west point is much washed away and shortened, the sand stretching from that point is by that means much lengthened, and determines both the flood and ebb more over to the eastward than before: and so far will it be from doing service to the channel to extend that point, if the vegetable soil was only secured in its present limitations, and the point of sand entirely scoured away, it would certainly be much better for the channel, for then the ebb would not be so inclinable to go down the west channel, but would proceed more directly to the bar, and act upon it with much greater force than now, and consequently keep it lower, and maintain the east channel better; and then, perhaps, the west channel might gradually grow up. And happy would it be for Lynn, if that channel was entirely stopped up, for it is the quantity of ebb that goes down that channel, that so weakens the current in the east channel, that instead of scouring away the points of sand which project into it, it is stopped and retarded by them, and formed into vortices and eddies which throw more and more silt upon them, and in some places (as at the bar) extend them quite across the channel; for it is by this means, and by the flood tide coming up the west channel, and forming an eddy at its entrance into the east channel, that the bar so much complained of is formed; for it is observable that this bar lies not far below the mouth of the west channel, just about the place where one might expect such eddies would occasion it.

A jetty therefore at the west point, seems to me quite wrong, and I think will be very hurtful. If, therefore, a jetty must be erected, I would advise it not upon the west point, but about a furlong to the westward of it, to extend itself to the northward, along the east part of the Brest Sand. This would allow the ebb to scour away the sand that stretches from the west point, and turn it more directly down the east channel towards the bar; and would at the same time very much secure the east side, from the violence of the westerly and north-west winds, and be a great shelter to the harbour too from these winds. And if the west channel could be stopped up, by the sinking of old hulks loaded with stones, or any other means, so that the ebbs might be prevented from taking their course that way, we might then have great hopes of maintaining the east channel, in a much better state than it has ever yet been in.

But as some gentlemen are apt to imagine, that a jetty on the west point, by turning the ebb-water more over to the eastward, will direct it more into the east channel, it must be acknowledged that it would have this effect, if this channel was situate to the eastward of that point. But the east channel itself is situate far to the westward of that point, and consequently the more the ebb is carried to the eastward by the jetty on its south side, the more westerly must be its direction on its north side, to arrive at that channel; and when once it has received this westerly direction, the west channel

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and other slade ways lie so fair to receive it, that in all probability very little of it will go down the east channel.

The way then to direct it down the east channel, is not to turn it more to the east at the west point, it going far much to the eastward at that place already. But the way must be to let that point of sand wear away, that it may take its course more in a direct line for that channel. Some may object, that the wearing away of that point will lay the harbour more open, and make it more turbulent and unsafe than at present. But in answer to this, a jetty from the west marsh to extend northward, along the east part of the Brest sand, will in a great measure prevent that. However, it is to be observed, that the serenity of the harbour and the goodness of the channel are two different things, and what procures one may be pernicious to the other. The goodness of the channel will be promoted by the quantity of water that comes into it and flows through it, but the greater the quantity of water, the greater the agitation, and the more turbulent. On the contrary, the less the quantity of water the less the agitation, and the quieter the harbour, but then the worse the channel. When such works are undertaken, therefore, the end and purpose should be well considered, and things inconsistent in themselves should not be pursued at the same time.

However, it is not to be expected, that these or any other means, can render the channel constantly and unchangeably good, so long as its course lies betwixt and amongst such loose and movable sands. A rage of winds and tides, or an extraordinary time, either of drought or rain, will occasion great alterations in it, sometimes for the better and sometimes for the worse, because even when the back waters are the strongest, and so the most likely to preserve a good channel, they will sometimes scour away the sands in one place, and let them drop in another place, where they may be more prejudicial to the channel than before; and thus will the state of the channel be always liable to changes and alterations.

No. 228.

Case submitted for Sergeant Grose's Opinion.

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Case submitted for SERGEANT GROSE'S *Opinion.*

The town of Wells is situated on the north coast of Norfolk, and has been immemorially a seaport and harbour for ships and vessels. The harbour and channel was originally formed, as is apprehended, by the influx and reflux of the sea (no fresh-water river appearing ever to have an outfall there), and before the embankments after mentioned, when the tides came in, they ran freely from the sea through the channel or harbour, by the side of the quay or landing place, into certain creeks and rivulets in the salt marshes, eastward of the town, and in spring tides overflowed those marshes, and in their reflux returned to the sea by those creeks or rivulets through the harbour (by the side of the said quay), and through the channel uniting, as it were, in a kind of forcible body in the creeks before they reached the harbour, by the side of the quay, and by such reflux scoured out and kept open the said channel and harbour from all obstructions of the influx of foul water or otherwise, and preserved the harbour and channel of a sufficient depth for navigation. This port was formerly thought of such consequence that, in 1660, an Act passed to lay tonnage on goods imported there, for the repairing and preserving the quay or landing place. Part of the said salt marshes were formerly used as a common, and the beasts, or more properly the great cattle of the owners or occupiers of commonable tenements in Wells, used to feed their cattle thereon, when not overflowed by the spring tides; but such feeding being of little benefit, the lord of the manor, who fed sheep there, did, between 50 and 60 years ago, embank and enclose about 100 acres of the said salt marshes, and thereby prevented the tidal waters from flowing over the same, and into the creeks within the said embankments, (one of which creeks was so large that boats used to be navigated in it to the east part of the town,) by which means the body of water returning by reflux to sea was much less, and of course the force of scouring and keeping open and deep the said harbour or channel by such reflux became languid.

It is reported, though perhaps difficult to be proved, that some of the inhabitants predicted this evil, and that the lord promised, if any such should happen, he would take down his bank; but this is a matter of general tradition among the inhabitants; though one person particularly remembers having heard a relation, now dead, exclaim much against the embankment, as tending to the ruin of the harbour, and blame the inhabitants for not throwing it down. In a short time after the embankment was made (which greatly decreased the indraught, and of course the reflux of the tides) the bad effects of it was experienced, for the harbour and channel became considerably shallower, and the navigation much more tedious and hazardous, and ships of the usual burthen could not get up to the quay or landing place to deliver their cargoes. To remedy this growing evil (the lord not taking away his newly-erected banks) a merchant in Wells, on or about the year 1738, formed a plan of converting one of the largest creeks (which was in the unembanked part of the salt marshes) into a reservoir for making an artificial scour, and the same for some years had the desired effect, and kept the harbour and channel in a navigable state; but, from unforeseen accidents, and the slight manner in which his works were done for want of an adequate fund, the same became afterwards of little use, and the harbour and channel grew up again; and, although some trade was carried on for many years afterwards, it was attended with great delay and expense, by unloading part of the cargoes of the ships to seaward of this town. In 1760, the then lord (heir of the late lord), finding that he could embank about 60 or 70 acres more of the said salt marshes at a moderate expense, did embank the same, within which was one creek very useful for scouring, by the constant flow of the tides therein, whereby he put a further check or stop to the in-draught of the tides, and consequently lessened the reflux so necessary for the purpose of scouring and depthening; and in a very few years after the second embankments, the harbour and channel grew up so much faster than it did before, and rendered the navigation more difficult, insomuch that the merchants and inhabitants feared the total loss of the harbour, and of their trade; and therefore they, in 1765, entered into a voluntary subscription for reinstating the reservoir before mentioned, which they did in the best manner their subscription would allow, and the same was for some time of great service by scouring out the harbour; but as works of this kind could not be supported without frequent repairs and great expense, an Act of Parliament was obtained in 1768, wherein is recited the said Act of 1663, and further "that the duties thereby made payable had not been sufficient for the effectual reparation and improvement of the harbour and quay of the port of Wells, which, notwithstanding a great sum of money raised by a voluntary subscription of the merchants and shipowners belonging to the said town, were still encumbered with a considerable debt, and the said harbour and quay, would in a short time fall into decay, unless some further and more effectual provision should be made by Parliament for the preservation thereof; therefore for preserving to the inhabitants of the said town of Wells, and the adjacent country, the benefit of the said harbour and quay, which was of great importance to the trade of the kingdom in general, and to the end that the same might be cleared and depthened, and the said quay repaired, improved, and maintained, and the present debt paid and

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discharged, it was enacted, that the tonnage of the said Act of 1668 should cease, and another tonnage therein mentioned should be paid, to be applied by certain Commissioners therein named. That A., B., C., D,. &c. shall be and they are hereby appointed Commissioners and Trustees for the executing and affecting the powers, authorities, and purposes of this present Act, until the said debt shall be paid and discharged. That after the aforesaid debt shall be paid off and settled, it shall and may be lawful to and for certain persons therein named, to nominate other persons, who shall be, and are hereby constituted Commissioners and Trustees for executing the powers and authorities of this Act, and that it shall and may be lawful to and for the said Commissioners or Trustees for the time being, or any five or more of them, to direct all matters and things, and to cause the same to be done and executed from time to time, as by them shall be thought requisite and necessary for improving the said harbour and quay of Wells, and for other the purposes herein-before mentioned. That it shall and may be lawful to and for the said Commissioners and Trustees, or the major part of them, to make such bye-laws, rules, orders, and regulations, as shall be found necessary for the purposes in this Act mentioned, and to contract and agree with workmen, artificers, or other persons whatsoever (*bonâ fide*) for making and doing all and every part of the work and business to be done in or about the preserving and maintaining the said harbour and quay; and also with any person or persons for timber, stores, or other materials which shall be required for the purposes aforesaid. And to the end that sufficient sums of money may be raised for the purposes aforesaid, for better securing the same, be it further enacted, that it shall and may be lawful for the said Commissioners and Trustees for the time being, or the major part of them, by indenture, to convey and assure the said duties granted by this Act, as a security for any sum to be borrowed for the ends and purposes aforesaid, not exceeding 1500*l.* and that all monies which shall be raised, received and borrowed by virtue or under the authority of this Act, shall be applied and disposed of, in the first place, for and towards the paying and discharging the expenses of obtaining this Act, and afterwards for the improving, preserving, and maintaining the harbour, quay, and other works belonging thereto, and for paying and discharging the debts already contracted, and to and for no other use whatsoever."

The Commissioners and Trustees proceeded in the execution of the said Act, to the amount of in making another sluice in a creek, in the remaining unembanked part of the salt marshes, and doing such works as on advice of engineers were then thought would keep open the harbour and channel; but, by an unexpected circumstance of the floor and joists of the sluice being destroyed by a worm, (never before known there,) the sluice and other works are now rendered almost useless. Many of the traders and inhabitants of Wells know that the tonnage under the present Act has been a great burthen on the trade, to the decrease of it, and fear the success of renewing the sluice, which will cost more money than the Commissioners are able to borrow under the present Act; they, also being apprehensive that after-tonnage would hazard the loss of the trade of the port, and being convinced that the indraught of the tides is restrained by the above-mentioned embankments, which prevented the flow and reflow of the tides into and from the creeks and channels, and upon and from the marshes, into and over which the tides anciently flowed, was the principal cause of the first silting up, and decay of the harbour near the quay and channel, and was the original cause of incurring the expenses of the sluices, are desirous that the tides should be admitted again into the creeks and channels, and over those marshes they were wont to flow previous to their first embankment between 50 and 60 years since, and into the second embankment made in the year 1760, as the same admission would be attended with very little expense, and be, as far as human foresight could suggest, the most probable means of restoring the harbour and channel to their ancient and good state; and if the tides cannot be so admitted, they have been advised by an engineer that a new sluice must be erected with stone and other materials not liable to be hurt by the worm, at an expense of not less than 2000*l.*, and other new cuts or creeks made through the unembanked part of the salt marshes.

Therefore your opinion is desired, whether embankments made as above stated, which totally stop the flow of the tidal waters into the creeks and channels, and over the marshes, where they were wont to flow and reflow, for the keeping open and deep the harbour and channels of the Port of Wells, and in one of which creeks, before the first embankment, a navigation of boats was carried on, are not nuisances? And if you are of opinion they are, in what manner you would advise the traders and inhabitants of Wells, who would be so materially injured by the continuance of them, to proceed for getting them removed? And if the Commissioners under the Act should think it right for them to interest themselves in removing and abating the nuisances, have they power to apply any part of the monies raised under the Act obtained in 1768, in pursuing such means as you shall advise.

SERGEANT GROSE'S *Opinion.*

31*st January*, 1778.

Sergeant Grose's Opinion.

I am of opinion that all the embankments which, by preventing the flow and reflow of the tides, stop up the harbour, and are prejudicial to the navigation, were nuisances at the time they were made; but some of them have existed so long that there will be some difficulty in getting them removed; the best way to attempt it will be by indicting those persons who have made or continued the last of the embankments which are prejudicial to the harbour. It would be of too dangerous a consequence, I think, to attempt to abate them, by pulling them down, because the mischief might be infinite, and might be prejudicial against those who endeavour to remove the nuisance. I think the Commissioners under the Act for preserving the harbour, by virtue of that clause which enables them to do what they think fit for the purpose of improving and maintaining it, may apply as much of the money raised under the Act in support of such a prosecution will in my opinion be doing that which will assist to improve and maintain the harbour; but before such indictment is preferred, or anything done towards removing the embankments, I would recommend an application to be made to the Lord of the Manor, stating the inconveniences occasioned by the embankments, and begging him to remove them. If he sees the application in its proper light, I think he may find out some plan to remove the nuisance complained of without doing much injury to the land embanked, which would be the most desirable object on both sides.

RESULT—1779 to 1784.

It appears that three trials took place in the Court of King's Bench, and that two verdicts were found for the Commissioners. On the last trial, the Court allowed for costs and expenses 562*l.*, which was paid by the representatives of Sir John Turner. An injunction which had been granted by the Court of Chancery, in 1781, restraining them from removing the banks, was dissolved, and they were at liberty to throw down the same.

APPENDIX B.

WELLS.

No. 229.

Hodskinson, Grundy, and Hogard, and Nickalls, on the Decay of the Harbour.

No. 229.

Reports by Messrs. HOOSKINSON, GRUNDY *and* HOGARD, *and* NICKALLS, *on the State and Causes of the Decay of Wells Harbour.*

London, 5th July, 1782.

GENTLEMEN,

From my views, surveys, and observations made thereon in March, and April, 1782, I found the navigation of this harbour much obstructed by the crookedness and irregularity of the channel, and the shoals and sand-banks left therein by the tides.

To inform myself of the causes of these obstructions and impediments, I first inquired of several pilots and harbour-masters* belonging to this port, into the ancient and present state of the low-water channel at sea against the mouth thereof, both as to its distance from the shore and height of its surface, in order to judge whether the cause of these obstructions originated from any changes of the channel, sand-banks, or currents in the main ocean; and I found that the state of the low-water channel was the same then as it had immemorially been, both as to its distance from the shore and height of its surface, for that the line of direction for the lower or outermost buoy was then, and had immemorially been Brancaster Mill and Burnham Point. I then inquired into the manner and direction of the influx of the tides into the mouth of this harbour, and was informed, that at the first of flood the set of the tide or current at sea runs from the Point of Foulness past the Harbour of Wells, in a west-north-west direction, to the point of Hunstanton for six hours, and joins itself with the ebb tide setting out of Wells Harbour, and both run to the west-north-west together during the space of three hours (being the first part of the aforesaid six hours), and then the water is at its lowest ebb; and that then the tide of flood begins to act upon the shore, and gradually enters the mouth of the said harbour, the tide or current having then three hours to run to the west-north-west, which finishes the course of the western tide.

I was also informed, that the harbour towards its mouth had shifted above a mile to the eastward within these 23 years last past, as described in the plan annexed by the letters AA; but that the main channel before that time used to run on the western side of the Scolph at B, and from thence in a north-west direction into the sea, which made the entrance of the harbour very commodious and safe for ships, as they then came in always in a south-east direction before the tide, that is, with the set of tide at sea (as at Arrows CC), whereas, since the shifting of the channel to the eastward, the navigation is become very dangerous, by reason of the strong tide setting to the east-south-east, which forces the ships to sail in against the tide, that is, in a west and west-by-north direction. For instance, when a vessel of burthen wants to come into the harbour, the time of coming in should be at or about half flood, at which time the set of the tide turns at sea (as at Arrows CC), and renders it impossible for ships to come up from the turn at the second buoy to the scolph, unless the wind blows strong from the eastward; but this was by no means the case when the harbour's mouth was in the old direction, as at dotted line BB. Again, when a ship of burthen wants to go out of the harbour, the time should be at the first quarter's ebb, when the current at sea sets over the sands, as at CC; but it is now impossible for a ship to get from the second buoy over the bar to sea, unless the wind blows fresh from the south.

I was also informed, that by the time the western tide or tide of flood had finished its course, the waters reach Wells Quay, and then the tide turns to the east-south-east at sea, across the harbour's mouth (as at Arrows CC), and runs for the space of six hours. That during the first three hours of the tide's running to the east-south-east, it still continues to flow at Wells Quay, and that it used to flow about one hour longer upon Warham Slade (No. 7, shaded red). That when it was high water upon Warham Slade, the tide was fallen about 6 feet at the harbour's mouth, and that then the ebb tide began to make its way from the quay to sea, and that when sunk about 2 feet at the quay, then the reflowing waters began to make their way from Warham Slade, and being joined by other reflowing waters from different creeks and channels, ran with great rapidity in a confined channel to sea. That the ebb tide at sea having then about two hours to run to the east-south-east, and its force being of course very much weakened, the ebbing waters from the slade, creeks, and channels, being much stronger than the said ebb tide at sea, used to force their way into the main ocean, and then run for about three hours in a north-west direction, until the tide at sea began to return in a west-north-west direction past the said harbour, and then the ebb tide from the said harbour, having about three hours or half its time to run, was carried along with the flood tide at sea in a west-north-west direction, and by that means the channel was kept open in a north-west direction, as at BB.

I was also informed, that by means of the flow and reflow of the tides in manner herein before-mentioned, the said harbour, creeks, and channels used to be scoured, cleansed, and kept open, and all the sand and silth which was constantly brought up by the tides was carried back again, and prevented from lodging therein and choking up the same; and that the said harbour did then afford a useful and commodious navigation for ships and lighters, to the great benefit and convenience of merchants and others trading to and from Wells aforesaid.

I inquired of navigators, whether they had observed any alterations in the channels of the Humber or Lynn Deeps, to which the defects in this harbour could be attributed, and was informed that the tides in those channels acted in quite different directions, and not towards the mouth of Wells Harbour, so that the harbour could not possibly be affected by the tides coming either from the Humber or Lynn Deeps.

I also asked the said navigators, whether they had observed that the sea had retreated from this coast within their memories; they answered it had not, but that, on the contrary, it had gained in many parts thereof, particularly at Hunstanton, Cromer, and Holkham, which last place adjoins to the parish of Wells.

In order to prove the truth of the foregoing informations, on the 29th of March (it being then full moon), I proceeded to the harbour's mouth at A, where I arrived at low water, or thereabouts (it being 12 o'clock), and I stayed there till the tide began to flow, which it did at 25 minutes after one, there being then 18 inches' depth of water upon the bar at A, and the wind then blowing a strong gale from the south-west and by west.

From hence I proceeded to the Pool at E (distant from the harbour's mouth about two miles), where the tide began to flow at three o'clock.

At Wells Quay, (distant from the pool eight furlongs and a half), the tide began to flow at 39 minutes past three o'clock.

At the bank made by Sir John Turner at F (distant above the quay six furlongs), the tide began to flow at twenty-one minutes past four o'clock.

I also found that it was high-water at the mouth of the harbour about six o'clock.

At Wells Quay forty-six minutes past six o'clock.

At Sir John Turner's bank (F) at fifty minutes past six o'clock.

The high-water of the aforesaid tide at Sir John Turner's bank, F, was higher than the surface of Warham Slade (No. 7) by two feet eight inches and a half, which shows that, had the Slade been open, it would have been covered two feet eight inches and a half by this tide.

I also found by the wreck of a large tide, which happened about six months before, that the same rose three feet higher than the foregoing, which tide would have covered the surface of Warham Slade (had it been open) five feet eight inches and a half.

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* James Powditch, harbour-master and pilot, aged 40 years; Peter Fairweather, mariner and pilot, aged 64 years; John Mountain, mariner and pilot, aged 53 years; John Springold, mariner, late harbour-master, and surveyor of the works; John Matsell, mariner, aged 76 years; William Powditch, a pilot, aged 30 years; Thomas Bird, a pilot, aged 35 years.

APPENDIX B.

WELLS.

No. 229.

Hodskinson, Grundy, and Hogard, and Nickalls, on the Decay of the Harbour.

From these inquiries and observations, I am fully satisfied that the information given to me as aforesaid is founded on truth.

From hence I concluded, that the causes of these obstructions were not to be sought in the main ocean; and therefore I turned my inquiries internally, and examined the state of the harbour and adjoining country from low-water mark at sea to Wells, and from thence upwards through Warham Slade to the Shepherd's House, and also the plans thereof taken by the late Mr. Elstobb and Mr. Turpin, and also that taken by Mr. Beiderman.*

This harbour is a collateral branch of the sea, extending through a sandy and shingly beach, and low and flat marshes called Salt Marshes, lying on each side thereof, containing before any embankation thereon about two thousand five hundred and sixty-five acres, as described in the plan by the green, blue, yellow, and red shades, and numbered 1, 2, 3, 4, 5, 6, and 7.

In these marshes there are a large number of deep channels and creeks, formed by the operation of the tides.

The influx of the tide, at the same time that it filled the harbour, used heretofore to fill all the channels and creeks, and in large spring-tides overflowed the whole of these salt marshes, and thereby formed a natural reservoir which contained a body of water covering two thousand five hundred and sixty-five acres.

The tides flow about three hours and seven minutes, and ebb eight hours and fifty-three minutes, at Wells Quay: and flow about two hours and twenty-nine minutes, and ebb nine hours and thirty-one minutes at Sir John Turner's Bank (F); and it appears that, if that bank had not been raised, the tide of the sea would have ebbed off, and the water would have fallen very considerably at the mouth of the harbour, at the time when the water at the upper extremity of Warham Slade, near the Shepherd's House, would have been at its full height: and this vast body of tide-water upon its reflux, acting with an accelerated velocity, and for a great length of time, upon the harbour so emptied, used heretofore to grind and carry away the muddy matter brought therein by the influx of the tide, and to keep open and deep the channel from Wells to the sea, thereby forming a good and perfect navigation. In which state (as I was informed) it continued till several embankations were made, and large quantities of salt marshes taken in and cut off from the action of the tides.

These embankments, being three in number, were the subject of my particular inquiries as to the quantities of land embanked, and the effects they had upon the harbour.

The first embankation, which I shall mention, inclosed a certain piece of marsh land which belonged to the late Lord Leicester, together with another piece of marsh land, which was inclosed by the late Sir C. Turner, both lying on the west side of the harbour (see the Plan, No. 1 and 2, shaded blue); these embankations inclose, in the whole, about six hundred and sixty-eight acres, and were made (as I am informed) upwards of sixty years ago.

The second embankation was made about the same time as the first, and inclosed a piece of marsh land lying on the south side of the harbour of Wells, and containing about one hundred and ten acres, which is called the Church Marsh, and is marked on the Plan No. 6, and shaded yellow; and I observed, that in making this bank the engineer (Mr. Kenderly, a man of experience in his profession) seemed to have been aware of the damage which this harbour would have thereby sustained, if he intersected the main channel at F, and therefore at a very considerable expense, more than would have attended such an intersection (although Sir Charles Turner would thereby have gained a larger quantity of land) he carried his bank in the direction O O O O, leaving the said main channel open to the harbour.

The third embankation was made by the late Sir John Turner, about twenty-four years ago (as I was informed) and inclosed another piece of marsh land (marked in the Plan No. 7, and shaded red), which contains about sixty-six acres, called Warham Slade, part thereof lying in Warham and the remainder in Wells.

These embankations contain together about eight hundred and forty-six acres, being about one-third part of all the said marshes, channels, and creeks, and are, in my opinion, the sole cause of the obstructions formed in this harbour; because by thus lessening the re-acting power of this great and natural reservoir, the operation of the tides has been weakened, and the counter-action of the reflux rendered incapable of grinding out and carrying away the muddy matter brought in by the influx, as it used heretofore to do, and because there are no material living waters falling into this harbour to assist the said reflux.

But the mischievous effects of these embankations are not all alike, but proportionate to their situation and to their distance from the harbour.

The first embankment (Nos. 1 and 2), whereof four hundred acres only drained into the harbour, was not productive of such ill effects as the second and third embankments, because all the waters in this embankment, save and except those contained in the creeks and channels thereof, used to reflow to sea at the first quarter's ebb, and before the channel from the Pool to sea was sufficiently emptied to receive the same; and therefore, instead of passing through the channel, all these waters, except the small quantity contained in the creeks or channels, went with the eastern tide to sea, and never had any scouring or grinding effect on the harbour.

The second embankment (No. 6) was, in my opinion, of greater hurt to the harbour than the first, because its situation is more distant from the harbour's mouth, and consequently the reflux of the tide-waters acted longer thereon, and the time they acted in the channel there was during the last quarter's ebb.

And it is evident that these two first embankations were attended with great mischief to the harbour, because about the year 1748 (as I was informed) a sluice or jetteau, called Friston's Sluice or Jetteau, was erected, and other expedients used, in order to keep back a quantity of water from the marshes lying on the east side of the channel, by way of reservoir, to remedy the loss of waters the harbour had sustained by these embankments, and to let the same off upon the tide of ebb; but these expedients did not last long (as I was informed), yet while they did some benefit was found thereby.

By the third and last embankment, made by the late Sir John Turner (F), Warham Slade and the creeks and channels therein were inclosed, and the main channel or uppermost part of the harbour itself, in extent about one mile and a half, were wholly lost, from sixty-six acres of land, which that embankment contained.

This embankment of Warham Slade was, in my opinion, far more detrimental to the harbour than the former embankments, Nos. 1 and 2, because the body of tide-waters contained therein did not reflow to sea till the last quarter's ebb, and as the waters in the lower parts of the channel had before that time ebbed off to sea, so these waters had on their reflow a grinding and scouring effect throughout the whole navigation, and more particularly so as they entered the harbour in a true line of direction; and the injury must appear greater when it is known that the harbour does not afford any expedient to supply the want thereof.

In order the more fully to explain the degrees of mischief this harbour has sustained by the loss of the back waters taken from it by the aforesaid embankments, and their effects on the reflow wholly lost, I have calculated their quantities and weights, which I find at a low computation to be as follows, viz.:—

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* Mr. Beiderman's plan is incorrect at the east end of the Great East Fleet, near Broad Arse; as there certainly is (and I am informed there always was) a passage to sea from the Out-Marshes, at the east and of the Great East Fleet.

APPENDIX B.

WELLS.

No. 229.
Hodskinson, Grundy, and Hogard, and Nickalls, on the Decay of the Harbour.

The West Marshes.

Part of the marshes embanked by the late Lord Leicester and Sir Charles Turner on the west side of the harbour (Nos. 1 and 2), containing about four hundred acres, discharged their surface waters into the lower part of the channel, and the quantity amounted to four hundred and ninety-eight thousand tons; but these surface waters never had any grinding or scouring effect on the harbour, as they went off to sea at the first quarter's ebb, and before the channel from the Pool to the sea was sufficiently emptied to receive same.

	Tons.	Tons.
The old channels and creeks in the said 400 acres, which drained into or had any scouring effect on the harbour, supposing them to be opened to their former dimensions, contained	..	74,699
Note.—The water upon the remaining part of the embanked marshes (Nos. 1 and 2) passed to sea through other courses, but did not communicate with the Haven.		
The Church Marsh.		
The marshes embanked by Sir Charles Turner, called the Church Marsh (No. 6), containing about 110 acres, discharged their waters into the harbour above the quay; which waters had a grinding and scouring effect throughout the whole navigation, and supposing the marshes to be overflowed at common spring tides 2 feet deep only (though in large ones they must have been overflowed 4½ feet), these surface waters amounted to	273,900	
The old channel and creeks therein, supposing them opened to their former dimensions, contained	19,913	
The total body of water contained in the Church Marsh amounted to	293,813	293,813
And the total body of water contained in the embankments of 1719, which had any scouring effect on the harbour, amounted to	..	368,512
Warham Slade.		
Warham Slade (No. 7), embanked by Sir John Turner in 1758, containing about 66 acres, discharged its waters into the harbour about 6 furlongs above the quay, and the quantity of surface waters (supposing the Slade to be overflowed 2 feet deep only at common spring tides, though in large ones it was overflowed 4½ feet), amounted to	164,340	
The old channel and creeks therein, supposing them to be opened to their former dimensions, contained	49,782	
The total body of water contained in Warham Slade amounted to	214,122	214,122
		582,634
The marshes now remaining open and uninclosed.		
Note.—These marshes (Nos. 3, 4, 5) contain about 1719 acres; all the surface-waters therein, amounting to 2,140,155 tons, reflow to sea at the first quarter's ebb, and never have any grinding or scouring effect on the harbour.		
The fleets and creeks therein, east and west, with the sluice waters which drain into or have any scouring effect on the harbour, contain		468,120
The total body of waters in all the marshes, channels, and creeks, before any embankation whatsoever, which had any scouring effect on the harbour, amounted to	..	1,050,754

	Tons.
From the aforesaid calculations it appears, that the waters which had any scouring effect on the harbour did, before any embankation whatever, amount to	1,050,754
Of which waters the harbour was deprived, by the embankments in 1719, of . . .	368,512
Therefore the waters were then reduced more than one-third of their original weight, viz., to .	682,242

Which last body of water did, as I am informed, with the small assistance it received for a few years from Mr. Friston's sluice or jetteau, erected in 1748, operate in such a manner as to keep and preserve the mouth of the harbour in its old direction, and the channel sufficiently open, deep, and wide, for the purpose of navigation, until some time in or about the year 1758, at which time the last embankment was erected for inclosing Warham Slade.

If, then, this body of water (viz., 682,242 tons) was sufficient, as it appears, for the above beneficial purposes, and if the present bad state of the harbour commenced at that period, it now becomes necessary to ascertain the body of water of which the Warham Slade embankment deprived the harbour, and from thence to point out its effects.

	Tons.
First, then, it appears, that Warham Slade contained of water	214,122
Which, being added to the waters of which the harbour was deprived in 1719, viz. . . .	368,512
will prove, that by all the embankments the harbour has been deprived of more than one-half of its original stock, or of	582,634

But as the embankments of 1719 have been erected above 60 years, and cannot (as I am informed) be now removed or called in question, it is proper to show the proportion of water of which the harbour was deprived by the embankment of Warham Slade, compared with the body of water which scoured the harbour and preserved the navigation as aforesaid from 1719 to 1758.

	Tons.
It appears, that after the embankment of 1719 there remained a sufficient quantity of water for scouring the harbour, viz.	682,242
By the embankment for inclosing Warham Slade, erected by Sir John Turner in 1758, the harbour was deprived of	214,122
	468,120

By which the waters left in 1719 were thereby reduced nearly one-third, and only four hundred sixty-eight thousand one hundred and twenty tons were left to assist the main channel in its reflux to sea.

When the situation of Warham Slade and its distance from the harbour's mouth, together with the direction and the time in which the waters from thence entered the navigable channel, is attended to; and when the foregoing calculations (by which it appears that nearly one-third part of the waters which supplied the harbour, and maintained the navigation from 1719 to 1758 as aforesaid, was cut off) are considered, it must follow as a necessary consequence, that the embankment of Warham Slade in 1758 was very prejudicial to the harbour, and the chief cause of all those evils and impediments which now exist therein. The reservoir of water upon Warham Slade was formed by nature, and was in point of situation superior to all the other reservoirs adjoining to this harbour. For upon the return of the tides the waters must first begin to ebb in the lower parts of a channel before the waters in the upper parts can give way; and it is known, that in the upper parts of a channel, at a considerable distance from its mouth, the tide will be flowing up, and the motion of the water upwards will be retained, after it has long ebbed and much fallen at the mouth and lower parts of it; from whence it is plain that the water at the quay at I, and at the lower parts of this haven, must have greatly subsided, and most or all of the sands and marshes bordering thereon must have been uncovered and laid dry before the ebb-waters from Warham Slade could be passed off; and as their power and force was increased by the increase made to their fall by the more early subsiding of the waters in the lower parts of the haven, so their power and force in scouring, cleansing, and preserving the navigable part of the channel through which the ships and vessels constantly passed and repassed, was very great; the waters therefore from Warham Slade must have been very beneficial to the purpose of navigation and commerce. And here it may not be amiss to observe, that the more remote from the mouth of a channel, and the larger the receptacles for the tide-waters are, the greater will be their power of cleansing, scouring, preserving, and improving that channel, as both the quantity and velocity of the ebb and back waters will be increased by these circumstances.

And if the waters left after the embankments of 1719 did as aforesaid exactly counterbalance (by their reflux or re-action) the mischiefs occasioned by the influx from that time to 1758, what must be the consequence if nearly one-third of this re-action is destroyed? The answer is evident: these mischiefs, occasioned by the influx, must remain in the channel and haven, and can only be imputed to the loss of those reflowing waters.

To explain the grounds and principles of my opinion, I beg leave to refer to Sir William Dugdale's "History of Embanking and Draining," which was written in 1662, where will be found several decrees and ordinances concerning embankments; and to Serjeant Callis's "Reading on the Statute of 23rd of Hen. VIII of Sewers," p. 54. And for the same purpose I have subjoined an appendix, containing extracts from reports made by several eminent engineers, and from other compositions upon the subject of embankments.

It has been said, that reservoirs have been used in France and elsewhere, with success, for keeping harbours open and clean; I answer, if reservoirs are proper expedients in this case, no place to make them in can be so eligible as Warham Slade, that being at the upper extremity of the harbour.

Upon the whole, I am of opinion, that the present bad and ruinous state of the harbour is to be in a great measure, if not wholly, imputed to the embankment of Warham Slade in 1758; and that if the tide of the sea is permitted to flow and reflow in its ancient course and manner over Warham Slade,* and if the harbour's mouth and channel should be first cleansed and restored to its former position, the navigation will be supported and maintained in a safe, useful, and commodious state by the natural operation of the tidal waters thereon; and that the harbour will be more benefited, and more likely to answer the purposes of navigation and commerce, by the natural support of the waters from Warham Slade, than by any artificial means whatsoever within the harbour, which can be executed without an expense too heavy for the trade of the port to bear.

These, gentlemen, are my sentiments, submitted to your consideration,

And am, &c.,
J. HODSKINSON.

*To the Commissioners for the Preservation of the Harbour of Wells,
in the County of Norfolk.*

APPENDIX.

Colonel ARMSTRONG, in his Report of the 12th of May, 1724, concerning the drainage of Bedford Level and the port of King's Lynn, pages 2 and 3, expresses himself to the following effect:—

"The great cause of the decay of Lynn harbour, in consequence whereof the fens could not drain off their waters, was principally owing to the tides being shut out of their ancient receptacles, viz., the Ouse, Stoke, Brandon, Mildenhall, and Grant rivers, by the dams and sluices erected at Denver; and this evidently appears in that, just before those sluices were built, the tides made clean work in Lynn haven, and maintained the river and channel of sufficient width and depth for navigation and draining. Soon after those were erected, these grew up and became incapable of draining, and precarious to navigation."—Again—

"And the reflux of the tides was heretofore so strong that they did not only scour out the sands brought in by the flux back again to sea, but enlarged and deepened the river, haven, and channel (as may appear by the authentic testimonies of the Commissioners of Sewers, the petitions of Marshland, Mr. Richard Atkins, &c.) until the works of the Adventurers weakened the said reflux; and therefore when these works are laid aside, and the tides and freshes are permitted to have their ancient course, they will separately, and in conjunction, work the effects they formerly did, and preserve a sufficient channel."—Again, page 12—

"Ostend did decay, when some marshes were embanked and the indraught was lessened, until those banks were destroyed and the old indraught was again recovered."—Again—

"Rye harbour, &c., has decayed by having such indraughts taken away by inners of marshes, and we say if private men, to get a little land, may be guilty of such encroachments, all our ports may be ruined in time, in the same manner that Lynn, Wisbeach, and Rye have been."

Mr. BADESLADE, in his "Treatise on the ancient and present State of the Navigation and Ports of King's Lynn and Cambridge," published in 1725, pages 13 and 14, expresses himself to the following effect:—

"And that the ebb of the tide alone, exclusive of the fresh waters, does scour and grind away to sea the silt brought up by the flood, and principally maintain their channel, is demonstrable. The harbour and channel of Wells in Norfolk is maintained and kept open by the sea water only (no fresh water river having its outfall there), the sea putting up its tides into a great many creeks, which occasions a great indraught, the water being received into those receptacles does in its ebb keep open the harbour, channel, and pool; and though the sea does leave some sand in the said creeks during the neap tides, and the channel rather grows up than deepens, yet the next spring tides overflowing a large tract of salt marshes, the said water, on the retreat of the tide, falling off those marshes into the said creeks, does drive out the sand dropped in them during the neap with such force to sea, that it grinds them and the channel and pool, and makes them deeper than they were before the spring tides put up.

"But since a considerable number of acres of salt marsh has been embanked and taken in adjoining to the port of Wells, and several creeks have had banks run across them, which hinders the neap tides from putting up into those creeks, as they were wont to do, and also the spring tides from overflowing the quantity of marsh they used before to cover, the said harbour of Wells, its channel and pool, have very sensibly decayed, as have done all channels that have been anyways deprived of their ancient stock of back waters."

Thus Mr. ATKINS writes:—

"Spalding of old time was best of three outfalls, now the worst; lost by winning certain severals to the seaward."

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* And in the old creeks and channels therein.

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Sir CORNELIUS VERMUYDEN expresses himself to the following effect:—

"The Ouse from Littleport to Lenne keeps its depth by reason of the back waters."—Again—

"The floods and ebbs of the sea maintain Boston Deeps. The reason why it keeps so deep is, that the ebbs which come over the sands which lie between Norfolk and these waters come that way, and so make a deep there which could not otherwise be possibly maintained It is not the river Welland, and that of Boston, could do it; they are but small waters, and the less powerful when they come abroad into a vast place where they are not to be discerned; so that if it were not for the ebbs of the sea it would soon decay."

See an ingenious Pamphlet, entitled, "Some Thoughts on Mr. Rosewell's and other Schemes now proposed for amending Lynn Channel and Harbour," page 11:—

"It is known by experience that the exclusion of the tide waters is sometimes the ruin of a harbour, as is evident in the instance of Wells harbour, which, while it had large receptacles for the tide-water above the town, was, by the reflux of that water passing off every ebb through the narrow channel along the quay, preserved in a tolerable good condition; but since these receptacles have been taken away by embankments the return of all that water is lost, and the harbour quite ruined for want of it."

Mr. LANGLEY EDWARDS, in his Report for the amending the Outfall of the River Nene, &c. dated 16th April, 1771, page 5, expresses himself to the following effect:—

"The three great causes of the destruction of the outfall which have happened in our times have been, first, the embankment of marshes (made about fifty years since) which lie below the present washway, and were overflowed by every spring tide, which in its reflux descended by large creeks, and kept a good channel either by Terrington Hole or the Eye downwards to sea."

GENTLEMEN, *6th July*, 1782.

Having accompanied Mr. Hodskinson in his survey of the harbour of Wells, in pursuance of your directions, we join and entirely concur in his Report, dated the 5th instant.

We are, &c.,

JOHN GRUNDY.
THOMAS HOGARD.

To the Commissioners for the preservation of the Harbour of Wells,
in the County of Norfolk.

GENTLEMEN, *Southwark, 5th July*, 1782.

In pursuance of your directions I did, on the 12th day of June last, and on the six following days, take a survey of the harbour of Wells and adjacent country, and upon comparing the same with the plan annexed, and receiving much information on the spot, and inspecting the plans made by Messrs. Ellstobb and Turpin, and by Mr Biederman, it appears to me that the map annexed is correct.

From the aforesaid view and information I found, that the channel from its mouth to the west end of High Bink, or south end of the Scalp (D) being more than one mile and a quarter in length, is in its present state perilous and uncertain for ships coming in or going out under any wind whatsoever; and that the navigation under many winds is wholly impracticable. This impediment or mischief to navigation arises from the serpentine form of the channel (AA) and the shoals and the sand-banks therein.

Near the Scalp, I took particular notice of what (I was informed) was the line of direction of the old channel (BB) to sea, and I observed a visible indentment or track in the said line, which, joined to the information given to me on the spot, induces me to think was the west boundary of the said old channel, and it appears to me, that the course of that channel was the natural passage from the Pool to sea, and that it would have been preserved and maintained in its old direction by the same means which at first created it, if those means had not been taken away: for while the channel was in that course (BB), the flood and ebbs of the tides had sufficient power to keep the same open, deep, straight, and clear of sand-banks, which they could not possibly have done, if it had been in its present line of direction; because the tides coming up and going down in a crooked course, must always have formed many eddies, occasioning deposits of matter, and from thence must have arisen shoals and other obstructions to navigation. If it was necessary, I could refer to many places in England, where large sums of money have been expended in remedying the mischiefs occasioned by crooked channels.

When I took a view of the spot called High Bink, I found it (and it evidently appears to be) of a very advantageous form, and in such a situation as to operate as a jetteau, and to give the tidal water a true line of direction to and from the Pool in the old channel. This spot is composed of such matter as to render it of great stability, for it has retained its old position without shifting, notwithstanding the change of the channel and the different operations of the tidal waters theron.

These observations and facts induce me to be most clearly of opinion, that the change in the position of the channel from the Scalp to sea, and the crookedness of its course, is not to be imputed to any external cause; I therefore inquired whether any alterations had been made in the marshes, channels, and creeks near the harbour, or in the courses of the tides, to which the present bad state of the navigation could be attributed, and was informed of the several embankments made on the west and east sides of the harbour, Nos. 1, 2, and 6.

I compute that the marshes Nos. 1, 2, 6, embanked in 1719, containing about 779 acres of land, used at many spring tides before and after equinoxes, and at other times in the year, to receive on their surface and into the channels and creeks therein about 4,239,155 tons of water, part of which passing High Bink, and on the west side of the Scalp, had a great effect in scouring the channel, and partly contributed to the preservation and maintenance of the harbour in its old direction.

By the embankments of 1719. the haven was deprived of a great body of water, notwithstanding which, as I am informed, the harbour, with the assistance of Mr. Friston's sluice and other temporary expedients, was maintained in its old course, and in a good navigable state, until some time in or about the year 1758, which leads me to the consideration of the embankment of Warham Slade at F, and the effects it had upon the harbour.

The body of water contained in Warham Slade amounting (as I compute the same) to 456,402 tons, was more effective in scouring the channel than the waters on the marshes embanked in 1719 (Nos. 1 and 2), because the marshes, Nos. 1 and 2, were very near the harbour's mouth, and the waters from thence ebbing much sooner than those contained in Warham Slade, No. 7, could do little more than cleanse their own respective channels and their collaterals; whereas the waters from Warham Slade were not only effective in scouring their own channels to the quay, but by reason of their late ebbing and joining with the waters from other channels, operated effectually on the quay and on the whole navigation. The waters from Warham Slade, from their great descent and the length of their course, acquired great velocity and force, and the lower parts of the channel, being nearly emptied before the return of these waters, were wholly left to their power, and the same passing in a narrow course and receiving assistance of water from the sluice and different creeks and channels, and a good line of direction from the point of land at High Bink and the south end of the Scolph, did, as I am informed, keep the channel sufficiently wide, deep, and in its old direction to sea, from 1719 to 1758; and I am of opinion, that if the waters from Warham Slade had

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been still permitted to flow and reflow in their natural course, as before the embankment thereof, the same would have continued to produce the same effects upon the harbour as they used to do, and would have maintained a good and deep navigation from the quay to sea as aforesaid.

There are no waters near this harbour which pass through the same in so commodious a direction upon their reflux, as the waters from Warham Slade; and if any artificial means should at any time be thought necessary, this harbour does not afford a more commodious and proper spot whereon they might be erected than Warham Slade. I mention this, because, notwithstanding the immense expense which the town of Wells has been put to in artificial constructions to supply the loss of water occasioned by the embankments, yet their purpose has not been answered; and, indeed, all artificial works must ever be liable to objections, which cannot be made to the operations and effect of nature.

To show the great utility of the waters from Warham Slade, I measured the current thereof at a furlong below the bank (F), and I found them to run no more than sixty-one feet and a half in a minute; and if the Slade had been then open, the current would have been so much greater as to have exceeded that of most rivers; and therefore I am of opinion, that if the embankment (F) was removed, the waters from Warham Slade would then operate in such a manner as to restore the navigation, and to prevent such obstructions and evils as now exist in the channel for the time to come, and that in such case there would be no occasion for the erection of any artificial works whatever.

As it may at first view appear that my calculations exceed those of the other engineers consulted by the Commissioners upon the business in question, I think it right to observe, that I have considered the tides before and after the equinoxes, and many others of like height, as the great, efficient, and operative tides. Attending to this observation, the Commissioners will find that the calculations nearly agree.

I have been informed, that the existence of Wells harbour has been imputed to chance. If it is considered that the sea has access to and from the parts adjacent to Wells, containing a large tract of country, over which the tide waters always flowed, and that those waters had no passage except through the haven, and that the ends of the West and East Fleets, next the haven, are by much the lowest, I believe that it will not be thought too bold in me to say, that whoever was the author of the above imputation could not have any great knowledge of the nature of harbours, or the natural means by which they are preserved. It may not, however, be amiss to give some account of harbours, whose existence may be imputed to chance with as much propriety as the harbour of Wells, and which have little or no assistance except what they derive from the natural operation of the flux and reflux of the sea.

No fresh waters of any consequence pass through Milford Haven.

Plymouth, the Sound, and Hamoaze receive no fresh waters, except a very inconsiderable quantity from the little river Tamer; a little river passes through Catwater.

Portsmouth harbour receives a trifling quantity of fresh water from a small overshot mill at Fareham, but the quantity is so small as scarce to deserve notice.

The fine and deep harbours of Langston and Chichester have been always supported solely by the flux and reflux of the tides.

The harbour of Selsey very much resembles that of Wells prior to the year 1758, and never had any fresh back water.

The harbour of Rye, once famous, was chiefly kept open by the natural operation of the tidal waters thereon, though at last it was ruined by embankments; whereupon Captain Perry, in the beginning of this century, surveyed it, and in consequence of his recommendation a new harbour was made in another place. In the year 1762 this harbour was surveyed by Mr. Smeaton, who, by his report of the 16th of February, 1763, proposed a plan for collecting a body of water for the purpose of scouring the harbour, and in his estimate the expense of the works necessary for collecting nearly or about 733,415 tons of water was computed at 26,751*l.*

If Warham Slade is opened, and the tidal waters permitted to flow and reflow therein as heretofore, nature will then supply the harbour of Wells with much more water from Warham Slade and the unembanked marshes than, according to Mr. Smeaton's estimate, could be obtained for the harbour of Rye for 26,751*l.*

I am told, that the harbour of Wells (being situated near a fine country for the production of corn) is the second harbour for the exportation of malt within the kingdom of Great Britain, as well as a good nursery for seamen; and therefore the importance of the matter referred to me by the Commissioners has induced me to give more than common attention to the subject of this report; and I am fully of opinion, that unless the embankment of Warham Slade is removed, and the tidal waters permitted to flow and reflow therein, as they used heretofore to do, this harbour must be destroyed.

I am, &c.

To the Commissioners for the preservation of the Harbour of Wells,
in the County of Norfolk.

JOSH. NICKALLS.

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No. 230.
Smeaton, on the condition of Wells Harbour.

Report of MR. JOHN SMEATON, Engineer, *upon the State and Condition of Wells Harbour, in the County of Norfolk.*

London, 4th May, 1782.

HAVING carefully inspected the present condition of the harbour of Wells, in the county of Norfolk, and the Slade marshes, &c., and other premises, objects of a suit, wherein Sir Martin Browne Folkes, Bart., and Robert Hales, Esq., were plaintiffs, and George Chad, Esq., and others, defendants; and having also carefully inspected the several plans and papers, containing the evidence produced in the said cause, the following facts, in part drawn from my own view of the premises, and in part from the evidence produced, appear to me to be well ascertained and agreed upon.

1. That the harbour of Wells has of late years grown into a worse state than it formerly was, and particularly since the embankment that took place in or about the year 1719. And

2. That for remedy of the complaints then subsisting in the harbour, in the year 1738, a work was constructed that had the name of Freestone's, or Fristan's Sluice, so called from the projector or builder thereof, whose name was Fristan.

3. That this work had a beneficial effect, in scouring away the mud and sand that annoyed the harbour and channel, from the mouth of the said sluice down as far as the pool.

4. That at that time, that part of the channel called the Pool was so deep, that at low water two or three tiers of vessels would lay afloat, and swing round at low water.

5. That in the year 1758 the last embankment was erected, which is the matter now complained of, and is the object of the present suit.

6. That the quantity of acres of ground enclosed and defended by the said embankment is nearly 17 acres in the East marshes, and 47 in the Slade marshes, together making about 64 acres; besides, and interspersed in which are creeks, formerly, and now containing water to the amount of about three acres, making altogether a surface of about 67 acres, or thereabouts.

7. That besides the above, there is not only a very large quantity of embanked land, which was chiefly taken in about the year 1719; but still a much greater quantity than all the embanked land put together remains unembanked, over all which the spring tides usually flowed before the embankments, but the neap tides rarely, which is now the case with the greatest part of the unembanked marshes.

8. That no fresh water river makes its way to sea through the channel of the harbour of Wells, nor

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indeed any considerable quantity of fresh water of any denomination, and that not only the channe that forms the harbour, but the several branches and creeks into which it is divided (as is particularly distinguished in the map made by Biederman, under the direction of Mr. Mylne), are all supplied with sea water on tide of flood, which reflows back to the sea on tide of ebb, and thereby forming a backwater, produces a scour that tends to keep the channel of the harbour open.

9. That in the year 1765, Freestone's Sluice having been originally constructed in a slight manner with fasscines, stakes, piles, &c., the mouth thereof was so much widened that its effect had been for some time past greatly impaired, and a new one was therefore built upon a new scale, which when erected reproduced the same effect, as to clearing the harbour and channel down to the pool.

10. That though the sluice of 1765 had been constructed with greater strength and care than that of Freestones (though upon the same model), in the year 1777 it was found to have been nearly destroyed with worms, on which occasion Mr. Wooler was called in to advise the commissioners, who reported his advice to build a new sluice in a new situation upon a new construction, and with such materials as the worm would not touch.

11. That on account of the expense, which was estimated by Mr. Wooler at 2000*l*., this work was not undertaken, but in lieu thereof proceedings gone into that terminated in the present litigation, on a supposition on a part of the commissioners, the defendants, that the taking down the East Marsh Bank, whereby the tides would be readmitted upon the surface of the 67 acres before-mentioned, would restore the state and condition of the harbour in every respect, or in all the most material respects, to what it was before the erection of that bank in 1758.

12. That however, the sluice since Mr. Wooler's report has been repaired, and appeared at the time of my view to be of the same construction as it had formerly been, and tending to produce the same effect.

13. That during the whole time since Freestone's Sluice was first constructed, viz., from the year 1738 to the present time, the operation of the sluices has constantly been (when in order) nearly the same, viz., that of cleaning and keeping in the same good condition nearly all that part of the harbour and channel that lies between the mouth of the sluice, and the upper or south end of the pool.

14. That since the year 1738, the pool has been filling up or growing shallower, in so much that at low water, at the time of my view, there was not above 6 feet water there.

15. That for a long period of years preceding all the embankments, the outfall or mouth of the channel of the harbour, lay very considerably more to the westward than at present, and that it has from time to time changed more to the east.

16. That formerly (that is within the compass of the last 20 years), the direction of the channel out to sea was north-west, and that at that time the flow of the tide being in the direction of the channel during all the tide of flood, it was easy with a proper wind to bring vessels from the sea through the channel into the pool and harbour.

17. But that since the channel has come more to the east, and the direction gradually veered about, so as to have now come to a north-east, or north-east by north direction, as it was at the time of my view, it is a fact, that whenever the tide has risen above the surface of the Broad Sands (the tide still keeping its former direction from north-west to south-east) it drives the vessels across the channel upon the eastern bank or sand, and therefore without a strong leading wind, vessels cannot enter without danger; and, in fact, since these changes have taken place many ships have been lost, notwithstanding the skill of the pilots, to the no small disadvantage of, and disparagement to the port.

18. That the distance from the quay to the outfall of the channel, is at present betwixt three and four miles, and that the channel both now and ever has run through large, broad, open sands, from the outward or north end of the pool to its outfall into the sea, which sand (being perfectly clean, and free from all particles that might create tenacity) when dried by the sun is capable of being blown by the wind, and moved by the common agitation of the sea, and very great changes are wrought by the action of the sea in great storms and tempests. And that this is the description of the sands in general, which lie extended many miles on this coast.

19. That the breadth of this sand, or distance from the pool to the low-water mark, has considerably increased within the memory of man.

20. The channel from the Shelf, without the north part of the pool to the sea, has now as much (and about the same) draught of water, or flow of tide at high water, as it has been known to have in man's memory.

21. That the port of Wells is of great consequence, not only from its situation with respect to the surrounding country, but also from the traffic settled in the place; and, therefore, that nothing ought to be done that can be of real detriment thereto.

I have thrown together the above leading facts, not only for my own ease in composition by avoiding more tedious descriptions; but that from this general view of the state of facts, I may be more readily followed in my reasonings thereupon.

From the above, there naturally arise the following questions:—

1. Is there any natural cause of the decay of the harbour of Wells?
2. Whether the embankment in question, made in the year 1758 has contributed thereto?
3. Whether the removal of that embankment will contribute to the amendment thereof?
4. Is there any natural cause in the decay of Wells Harbour?

To have a clear and comprehensive view of the cause of decay, it will be necessary to show the natural cause by which the port of Wells has been formed.

We are all apprized, that great as is the annual downfall of rains and snows upon the land, which run into the sea in every part of the habitable globe, yet the quantity of water contained in the sea is not increased thereby. This may, however, reasonably be expected, when we consider that the exhalations that form those rains and snows, are chiefly raised from the sea by the power of the sun and the winds.

The floods and torrents that make their way from the surface of the lands in consequence of the rains and snows, take along with them a great quantity of clayey, earthy, and sandy matter (intermixed with many other kinds of matter, which it is needless here to enumerate) down into the channels of the rivers, the particles of which are by violence of the torrents carried down to the sea, and there in appearance dispersed.

These particles of matter not being capable of being raised again and returned back to the land as the water is, it necessarily follows that the quantity of sand and earthy matter that is deposited in the sea, is in a continual, though apparently in a very slow state of increase, and by the constant flux of the tides and the agitation of the winds, those materials so deposited are capable of being removed from the parts adjacent to their entry into the sea, not only to the neighbouring, but even to very distant parts; and though the remarkable quantity of sandy soil in the county of Norfolk, may in part account for the vast quantity of sands upon the coast thereof (extending as it were in one continued chain from the coast of Lincolnshire, very much infesting the great bay between the two counties, called the Wash, and still extending coastways far beyond the part of Wells, even to Cromer). Yet it is by no means necessary to suppose, that they have all, or in the greatest measure, proceeded from the land of the two counties, to the coasts of which they now lay contiguous; they may as well have proceeded from parts far more distant; and brought hither by the incessant action of the winds and tides, they find a place better adapted to their reception and repose than those from whence they came; and, indeed, it may be not improbably supposed that they in part have come from those coasts, which by the particular set of winds and tides have been wasting for ages past.

It is, however, of no consequence to our argument to point out from whence they came; it is sufficient that they have come, and that being here deposited, and finding it a place where they are less liable to be removed away than to be brought hither, the quantity upon the whole must increase; and since there ap-

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pears no power of nature by which they can be returned to the high grounds or coasts from whence they came, it must follow that they must continue to increase, till some contrary power of nature shall take place that we are not acquainted with; or the place of their reception become entirely filled.

It follows then, that the attachment of sandy and earthy matter to this coast is in a progressive state of increase, which it is as much out of any human power to prevent, as it is to prevent the sandy and earthy matter from being brought down from the high grounds into the sea.

We need not, therefore, extend our views further to be enabled to see clearly; that in some former age, that is, in some state of progression of this great work of nature, there was a time when there was nothing more than a naked sand laid against the bare coast of the elevated ground, upon which the town of Wells now stands (which we may suppose similar to that which now lies between Wells Miels, or Marram Hills, and the low water at sea) which being upon one regular decline, the tidal water could flow and reflow over the surface without channel or creek; and in this state as there could be no harbour, there would not on that account be need of a town; but let the breadth of the sand gradually increase to double, and then the declivity would become too small for the tidal water left by the flood to make its retreat, so as to keep pace in its return with the ebb of sea; and therefore a body of water being thus left behind, and having a sensible declivity towards the sea, would naturally make its way in the lowest slades, and there cut a gully, which (if not formed gradually, as may rather be supposed) would soon be enlarged by the influx and efflux of the tide, and thereby a scour would be produced through this passage enough to keep it open, in a degree sufficient to let the water in and out, till it became so quiet, as in a manner to cease the operation of scouring. But the breadth of the sands still gradually increasing, a greater body and surface of water will want a passage, and the power of scouring will increase with it; the gully will therefore by the same slow degrees enlarge to a creek, or fleet, as it is here called; and less ones will be formed to conduct the water more readily into the larger.

The natural progress attending this operation is, that the parts of the sand the furthest distant from low water, being the least liable to be agitated by winds and tides, the sands intermixed with the finer particles of earthy and clayey matter brought in by the tide, are the most readily and quietly lodged there; and particularly the earthy and clayey particles will find a resting place, which binding the sand together, the whole will continue to rise till at a certain height, and in consequence of a certain length of time of absence, of the salt water each tide, and exposure to the sun and air, the surface becomes fitted for vegetation, and by degrees will produce a certain species of grass and become a salt marsh; and which grass entangling and locking up the earthy matter, will make the surface continue to rise; and still the faster, as the water upon the plain grass surfaces becomes more shallow; and, in consequence, more still, quiet, and free from the agitation of external disturbing causes.

During this period, as the marshes have increased in height, they have also increased in breadth; and, in consequence, a greater body of water will be left upon them. The gullies and creeks, therefore, as they increased in number with the increase of breadth, the larger ones would increase in size and depth; and if all were ultimately collected into one, as has been the case with the channel of Wells Harbour, the scour would be sufficient to maintain a channel, through which vessels may be brought from the sea; and thus an useful harbour would be formed, which would increase in depth and utility, by the continuance of the forming powers; but yet, only to a certain degree.

I have said, that as the marshes increased in breadth and height, more water wanting its passage to sea would be left upon them; and this, so far as it regards breadth is self evident; but as the increase of height diminishes the depth of water upon them at high water, that the quantity left behind upon the whole will be greater, needs some explanation.

In respect to this, it is obvious to every one that views the subject, that while the depth of water upon the marshes is considerable, the water makes its way to sea by settling gradually, and passes off in the nearest direction over the marsh surfaces, without having any need for the gullies and creeks as drains; it is therefore, perhaps, only the last half foot that may need the gullies; which, however, being thus limited to some certain thickness (be it half a foot, more or less), and this thickness much less than the depth at high-water, the quantity so left will be in proportion to the quantity of surface, and the number of gullies being also in proportion to the surface, the aggregate of the whole, and the scour thereof in the last channel will be proportionably increased also. It is also to be remarked, that in fact, the scour is not very material, till the water upon the marshes is ebbed near their surface, that is, just retreating into the gullies when the principal scour begins.

Under these circumstances, the scour and consequently the harbour of Wells would materially increase, while the neap tides covered the surface of the marshes; but as the same progression would in time cause the surface of the salt marshes to rise above the ordinary neap tides, the scour would then begin to diminish; because being not only deprived of the efflux of the water from the grass surfaces into the gullies a number of times in a fortnight, the scour of these gullies becoming immediately less, they would themselves begin to choke up and contain less following water; and, therefore, in both respects the scour being diminished in each particular gully, the scour of the whole must be diminished also.

It is most probable that this harbour, from the slow progress of the changes above specified, may have continued in a very flourishing state for a long term of years, reaching backward beyond all record; though for a part of that time it may have been in reality in a state of decay, and which we will not show will naturally result from the same progression of causes that carried it to its maturity, so that after having clearly seen from what natural causes the harbour has been produced out of the sea, without a fresh water river to give it birth, we shall then readily see the natural causes to which its decay must be attributed.

From what has been laid down it will appear most manifest, that the rising or elevation of the surface of the salt marshes, by a fresh accession of sea mud, which they will acquire more or less every time they are overflown, will not stop at the neap tides, but they will gradually rise higher and higher, towards the high-water level of spring tides; and, if after that, they were only to be overflown in the great springs or raging tides, yet as every one of these tides will deposit something, they will ultimately be shut up at the height of the extreme high water, though no embankment whatever was to take place, and this will also happen in succession to the gullies, creeks, &c.

For, as the surface of the marshes rise higher and higher from the neap towards the spring tide mark, they will be less and less often overflown; and the gullies made by the reflux of the tidal water from their surface, will become less and less considerable and capacious, and in consequence of want of reflow the creeks will suffer the same fate, and lastly, the fleets and main channel. But as the tidal water flowing in through the channel, fleets, creeks, and gullies, to the several extremities of its branches must flow back the same way, it is the extremities that will be first landed up; because every part betwixt such extremity and the sea, will have water beyond it to flow over or through it; and thereby producing some degree of a scour, will keep open a passage either greater or less, while any water can get beyond it, and hence we are to expect, that the parts of the channels the most distant from the sea, will be those that in a state of nature will sooner lose their depth and capacity, till progressively from the extremities towards the sea, the gullies, creeks, fleets, and main channel will become solid land: and so far it appears from testimony, that long before the embankation in the year 1758, nature had got so far in its progress in the decay of Wells Harbour that it was much complained of, and the upper part between the quay and the pool was got so bad, that the goods were in general lightered up to the quay; and that for remedy thereof, Freestone's Sluice was built in the year 1738, which produced a good effect in clearing that part of the harbour; and as it plainly appears from the preceding discourse, that the progression of nature has no tendency to cure the evils complained of, but still to increase them; in consequence, they are incapable of any remedy, except what can be applied by the ingenuity and labour of man.

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We now come to the second question, whether the embankment made in 1758, has contributed to the decay of the harbour of Wells.

From what has preceded it has been clearly shown, that as the keeping open and maintaining the channel entirely depends upon the reflow of the tidal water, or back water, as it is called, that whatever cuts off and diminishes this must be a detriment to the scour, and, consequently, to the maintenance of the channel. I therefore do not hesitate in saying, that all the embankments both east and west of the town of Wells, whose waters (received upon their surface, and into their gullies and creeks) made their way back to the sea by the channel of Wells Harbour, co-operated with the progression of nature, and thereby tended to bring on more speedily, a general want of depth; which, as it has been already remarked, will be first perceived at these parts of the tidal flow, the most remote from the sea. Nay, we may go so far as to say, that if a bucket of water is taken up in the upper parts of Wells Harbour, and not suffered to reflow it may prevent the displacing of some particle of matter that had been lodged therein by some proceeding tide; and in this sentiment, I suppose every engineer and skilful person that has viewed the premises will join, as a general opinion; and which, though very true as a general sentiment, yet the whole merit of the question depends upon the *quantum*, the how much damage could result from those artificial means. And as in this it appears that the opinion of different men have widely differed, I will proceed to state my own, with all the precision and clearness I am able.

Now, as the breadth of the sands continues upon the increase, we must conclude that the reflux of the tidal water from the whole surface covered, continues upon the whole, if not greater, as great as formerly; and therefore will maintain as good a channel to sea at the outfall at low water, nor does it appear from any testimony, that from the scolph to the outfall of the channel into the sea, there is a lesser depth at high water than formerly there was; the complaints and appearances of a diminution of depth of the harbour, are from the lower or north end of the pool upwards towards the town. It appears, therefore, that as the upper part of the channel that lays contiguous to the main land is landing up, in fact, the harbour is moving towards the sea.

It does not appear from testimony, that the filling up of the pool or its growing shallower (so that ships cannot now lay afloat, or swing round in tiers as they used to do at low water) has been a matter very much complained of, till since the embankment in 1758; but this does not hinder, but that the fundamental cause thereof may have existed, long before the ill effects have become sensible to seamen, and those using the harbour; and, indeed, it clearly appears to me, that the filling up of the pool, sooner or later, is only a link in the general chain of causes, that must operate so as to produce this effect, whether any embankment had ever been made or not

To see this clearly, we have nothing to do but to advert to the situation of the pool; for it begins just below or about were the west fleet falls into the main channel. This fleet receiving the drainage and back waters from the Holkam marshes, appears to have been anciently of much greater extent than at present, and, consequently, the back water, or reflow, must have been very considerable from this great extent of surface, as well as that which still lays unembanked; and which being joined by the great reflow of water from the East Fleet, the Little Fleet, and the Haven Creek, with all their extensive dependencies, must form a great and rapid scour of back water; and when it is adverted to, that it is confined into a narrow compass between the Holkam, and the Wells Marram hills or miels, we must expect no less than a very deep channel in this extent, well deserving the name of the Pool. That this confinement of the whole water, both of flood and ebb, between the hills just mentioned, gave an additional scouring power to the tidal water, appears further from this; that the pool never appeared to be of further extent northward, than till this opening between the hills is cleared, when the tidal water having opportunity of escaping on tide of ebb over the broad sands laying without those points, its force became dissipated, and the great and sudden scour ceased that caused this deep water; even in that age, when the whole scour was in its greatest degree of strength and perfection, and the depth and goodness of the harbour consequent upon it. But whenever (as has been shown) the scour beyond it became diminished, by the rising of the marshes above the high water of neap tides, the depth of the pool would begin to diminish; for the scours would then be unable to scoop out the sands, which would be continually brought into it by the north-west winds from the Broad Sands laying to the north thereof through Holkham Gap, and down the West Fleet from so great a depth as before.

Nor is the Holkham Gap the only resource from whence the sands brought down by the West Fleet might be collected; for I look upon it, that the inside (that is, the south side) of the Holkham Miel Hills, are continually melting down by winds and rains, into the great area or bay drained by the West Fleet, and those hills are continually supplied with fresh sand, blown up by the force of the north and north-west winds from the broad sands, that are yearly extending more and more from thence to the northwards into the sea; the highest parts of which broad sands, being frequently left at neap tides long enough to be dried by the sun, are by the wind capable of being blown up in great quantities, so as to make and continue these hills far above the high water of any tides whatever; though composed of nothing more than a blown sand, somewhat united by the bont grass that grows up through the same; of which there are very many examples in various parts of the kingdom.

In that age when the scour at the pool was in its full perfection, it is probable, that it was very much deeper than it has ever been reported to be by any testimony or record now extant; and so long as it continued deep enough for the purposes of shipping, there would be no cause of complaint; and till it became too shallow for ships to swing at low water, its diminution of depth would be little regarded. There is, therefore, no doubt but that the pool was growing shallower long before the embankment of Holkham marshes; as a considerable length of time must have elapsed, between the time when Holkham embanked marshes were just rising above the high water of neap tides, and their acquiring the height at which they were embanked; and which height, I judge, was not materially different from the present.

When the ground of Holkham marshes was become high enough for embankment, the natural scour arising therefrom, was doubtless greatly diminished from what it had been; and though they had not been embanked, it would have been still much less at this day. Yet so great a surface as 560 acres (the drainage of which plainly appears to have made its way out to sea by the West Fleet) being cut off all at once in the year 1719, and 108 acres more in the year 1721; the whole of this together amounting to 668 acres, may reasonably be presumed to have had some sensible operation in accelerating the effects, that nature in her progression would afterwards have brought on, though no artificial embankment had been made; but it by no means follows, that the effects of those embankments must be immediately perceived at the pool; this, by slow and imperceptible degrees, must be supposed going on before, and by less slow, but yet imperceptible degrees might be going on after. Yet this must be attended to, that in proportion as the scour of the West Fleet was diminished by the loss of the embanked marshes, the power of the same scour would be diminished to carry down the sand continually into the pool, in the degree in which it had used to do; so that till the great bay, which still continues to be drained by the West Fleet, was, as it were gorged with sand from Holkham Gap and Molkam Miels, it would not be brought down in so great quantities each tide, as used to have been before the Holkham embankment, and therefore, as it appears that the whole progress of this business is very slow, it must be expected to have been a series of years between the cause from the Holkham embankment and the effect becoming more perceivable, in the sanding up of the pool; and in case this necessary period of years extended from the year 1720 to the year 1758 (that is, near 40 years), at which time the last embankment was made, then those would become cotemporaneous events; and it would be no wonder, that the united effects of the Holkam embankment, and that of the Church marshes in the year 1719; and also of the west marshes of Wells in 1720, making in the whole 572 acres; together with the additional loss of scour from the surface of the Salt marshes, which yet remain unembanked, to the amount

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of between 1500 and 1600 acres (the drainage of all which have their outfall through the pool). I say, it would be no wonder, if under these circumstances, the united effects tending to land up the pool, should be charged to the account of the embankments made in the year 1758; if it was possible to suppose that the embankment made that year of 64 acres could have a sensible effect, as the object of this embankment amounted to no more than 1-34th part of the whole quantity concerned in producing it; when it remains problematical, whether the effect of the 572 acres taken in before (which is near nine times as much), would alone have been sensible, if the effect thereof had not been mixed with what might have arisen from nature's simple progression, in case its operation had been no ways disturbed by those of art.

I find myself, therefore, forced by fair induction to infer, that though strictly speaking, the effect of every thing that has an effect must be something; yet, that the embankment of the Slade marshes in the year 1758, could not in any sensible degree, capable of measure or estimation, contribute to the sanding up of the pool.

The effect thereof upon the outward part of the channel must be still more remote; for it does not appear from any principles of art, observation, or practice, that when a back water, even assisted by a fresh water river ever so large, makes it way through broad movable sands, it has any tendency in itself to make its way out to sea in this direction more than in that. The natural tendency of water is to make its way in whatever direction it finds the greatest declivity, and if that happens to be in the shortest direction, it has no natural tendency to gain a longer course as that would lessen the declivity. If water, therefore, is found going in a course that is not the shortest, we may conclude (and in examining we always find) that this longer course is owing to the intervention of some object; so placed, that the water can have in that particular part a more speedy descent, in a direction different from that which would form the shortest line of the whole descent; and from causes of this kind, a stream may have a course in every possible degree meandering, as we frequently observe in nature.

If, therefore, the course of the outfall channel to sea at low water was in a north-west direction, through the broad sands, as seems very well attested to have been the case in former times; and if at those times the course of the channel corresponded with the general set of the tides upon the coast, so that vessels going in or out through the outfall channel, were not driven out of their proper course by a set of the tide across the channel as is said to be the case at present, it may be imputed to some of those lucky causes that operated in favour of those times; as no strength of back water alone could have a natural tendency to produce this effect. And if the accidental operation of contrary causes, as suppose winds and tides (either considered alone, or as acting in correspondence with the regular progression of nature already described) has brought the direction of the out channel, into a situation less favourable to navigation than it used to be formerly; at the same time, it has produced a shorter course for it to sea than it would have, if returned to its former direction. I am, however, clearly of opinion, that no increase of back water even if added by a fresh water river, if artificially brought down, would ever cause it to return to its former north-western direction, so as to disembogue itself at a place considerably more west than the present.

I do not, however, mean to say that it cannot return; but that if it does, it must be in virtue of causes operating in a contrary way to those which have brought the mouth of the channel from the westward towards the east, and not in virtue of any change that can be expected to be wrought, simply by an increase of back water; for that would be to make a more rapid stream, have a tendency to go a longer journey to sea in preference to a shorter.

It is alleged, indeed, that from a general increase of the breadth of sands upon the coast, that it is now further from the north end of the pool to the sea than it formerly used to be; but this must be understood of the straight line from the said point to low water without regard to the direction of the channel, for though the present channel should be as long from the pool to the sea, or longer than formerly, yet from the general increase of the breadth of the sands, was the channel to go much further westward than now, it would have a longer course to sea at low water than at present.

Whatever may have been the particular causes that have brought the mouth of the channel more to the east than formerly, does not appear material to the present question; but to give satisfaction as far as I am able, I will hazard the following conjecture. It is an observation universally agreed upon, that the north-west winds make the highest tides in the whole German Ocean, the north-west winds then accompanied by higher tides will produce more agitation, and consequently carry more sands from the north-west eastward, than equal winds from the south-east accompanied with lesser tides will bring back; and as to the north-east winds, they according to the local direction of the coast here, directly tend to accumulate them upon the shore; and if this is a true solution, as I apprehend it is, there seems not the least likelihood that the direction of the channel should ever be permanently removed to the west, but rather that it should be carried further to the eastward than now it is. And what gives strength to the above conjectures, is an observation I had the opportunity of making upon my view, viz., that the outfall channel of the harbour of Blakeney (a few miles eastward of Wells, and situated in a similar manner, in regard to the course of its outfall channel through the broad sands) has shifted also more to the eastward than it was, by above half a mile in the last seven years; as appeared from the marks I was shown for its entry at that period, compared with its present place, notwithstanding that Blakeney channel has the advantage of two large fresh water rivulets, that make their way together through this channel, to its no small advantage towards keeping it open. The place also of the outfall at low water, of the east discharge from the salt water creeks called Warham Deeps, I was shown to have removed its place further eastward than it was at Michaelmas last by several hundred yards, and chiefly within the compass of the three weeks preceding my view, during which very strong north-westerly winds had prevailed. N.B. Warham Deeps lay betwixt Blakeney outfall channel and that of Wells.

There is one thing more respecting the outfall channel of Wells Harbour that it may be proper to touch upon, and that is the bar that is described in Biederman's map to lay across the mouth of the channel, so as to be prejudicial to the entry of vessels; but after what has been said, be the impediment arising from hence greater or less, it cannot be imputed to the embankment of marshes, but to the sport of the winds and seas at the place, which will further appear from this circumstance; that when I was examining this place at dead low water of a spring tide, viz., the 15th of March last, I did not observe there was any appearance of a bar, the course of the channel being right out to sea at north-east by north by the compass; yet in another season it may probably return.

Hence, from the above premises I must entirely acquit the whole of the embankments, as having been in any degree accessary to the disagreeable effects arising from the change of the outfall channel of Wells Harbour; what I have further to say, will come most naturally under the third and last question proposed.

3. Whether the removal of the embankment of the Slade Marshes, will contribute to the amendment of Wells Harbour?

It appears clearly from what has preceded, that the progressional operation of nature, which originally formed the harbour of Wells, and brought it to maturity is by its continuance gradually producing its decay, and finally will close it up and convert into firm ground, fit for arable purposes and those of pasturage, the very spots where ships have rode at anchor, and that this progression of nature cannot be countervailed in any degree but by the industry, art, and hand of man.

It is a fact well established by evidence, that previous to the erection of Freestone's Sluice in 1738, the upper parts of the harbour as far down as the pool had got landed up to that degree, that the shipping that chiefly lay in the pool, were obliged to have great part of their ladings brought and carried to and from the town by lighters. That upon the erection of Freestone's Sluice (which, as far as appears, was the very first attempt in this harbour, to counteract the operation of nature by art) this rude and simple piece of art succeeded so far, as in a very great measure, if not effectually, to relieve the distress that they then laboured

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under, viz., that of the quays being in a great measure inaccessible to shipping (a construction so rude, that though bearing the name of a sluice, would seem as if it had been one of the first attempts to obtain relief by art, before sluices had been invented), and hence we may infer, that if this did so much, what might have been done by a real sluice built upon a proper and regular construction. This sluice was attended with a beneficial effect, so long as it lasted, and when it went to decay, the part of the harbour affected thereby, reverted to its former state.

In the year 1765 they again set about to relieve themselves, not by building a sluice upon a better plan, but by erecting a new one on the same plan upon fresh ground, with better, and as they expected more durable materials; and this sluice reproduced afresh the effect of the former, which has, indeed, continued to this day; but in the year 1777 it was discovered to be defective, and liable to fail on account of the timber wherewith it was built being eaten with a sea worm that had attacked it, unknown in these parts before. On this occasion Mr. Wooler, an ingenious engineer, was called in; who very judiciously advised, not only to build a new sluice upon a new foundation, and of more durable materials, but of a different construction, so as to give a better effect to the issuing waters, and as the best means of preventing the harbour from going into a total decay. This salutary advice, however, appears to have been rejected by the commissioners of the harbour on account of the expense, and in lieu thereof they adopted another expedient, which they thought was liable to be attended with less expense, and would be quite as effectual; for, having observed on popular grounds, that as many things had gone wrong with the harbour since the last embankment in 1758, they concluded them to be the effects of that cause, and that removing the cause the effects would cease, and everything come right again. It shall be therefore now my business, fairly and fully to examine, what foundation there was or may be for such a supposition.

It appears to me, that there were no just grounds for their expectations. For in the year 1738, the waters of the Slade marshes had not been interrupted in their operation, and yet the harbour became choked, and got into so bad a condition as to call aloud for immediate relief. What reason then to expect it in the year 1778, when according to the natural progression everything had got worse? In 1758 Freestone's Sluice had gone to decay, and the harbour was speedily reverting to the state in which it had been before in the year 1738. Now, had the operation of the Slade marsh waters been observed to have been of any material consequence, the embankation in 1758 would have been opposed and objected to at the time, which yet does not appear; and had any ill effects appeared to have arisen from the embankment in the year 1768 (that is 10 years after the embankment, and three years after the re-building of the sluice) when an application to Parliament was necessary to get fresh powers to defray the expenses incurred by that erection, &c., it would have been natural to have endeavoured to get some equivalent for the damage; or, at least (as sluice building must then appear to be the best expedient), to have got powers over the grounds in the unembanked marshes, to have enabled them to erect such proper additional works as might from time to time be necessary (and which might have been expected upon easy terms, and without depending on leave being always given), in case any damage to the harbour had been felt or apprehended from the embankment; because, the more amicable the terms that subsisted at that time between Sir John Turner and the Commissioners, the less he could have opposed or denied so reasonable a request. But yet nothing of this appears, or indeed any other till after the year 1777, when Mr. Wooller had reported that a proper sluice was of the utmost importance towards keeping the channel of the harbour open, and clear of the sands that are constantly brought in by the tides, and that such a work would probably cost the sum of 2000*l*.

Respecting that part of the last embanked marshes that lays west of the ancient embankment comprehending 16 acres, it is evidently of no more account than any other 16 acres that lie immediately upon the haven creek, whose waters immediately ebb with the tide without passing through the sluice; that is, they could have other effect in scouring, than as making a part of 1770 acres that make their way to the sea by the pool. But, with respect to the 47 acres that lie eastward of the ancient embankment, and are called the Slade, or Slade Marshes, they appear to me to have a different import.

The reason why the waters passing the sluice have a greater effect in scouring, than those which return to sea without passing the sluice, is because by the contracted opening of the passage of the sluice, the waters that lay in the creek behind it are detained from ebbing so quick as they otherwise would have done; that is, their numerous mouths (which when always open, reduced the level of the water contained therein, to near upon the same level as that of the water in the main channel of the harbour) being stopped by dams made across, and united by cross passages into one, and the mouth of this being contracted by the work called the sluice; a body of water is held back in these creeks as reservoirs, which not being able to escape so fast as the tide ebbs in the main channel; it follows, that a body of water by these means is vended upon, and after the half ebb which discharging itself into the harbour, forms a scour when the depth is so much lessened as to operate with power in grinding the bottom, whereas otherwise it would have been so languid as not to have stirred a grain of sand or mud. This artificial scour thus procured, in some degree imitates the effect of a fresh water river, which in these situations is very greatly beneficial; not from any virtue there is in fresh water preferable to salt, in these cases (if any thing it is rather less, on account of its less specific weight) but from its having a fall from the land, and proceeding therefrom continually; it not only strengthens the ebb but running to sea at low water (when the fall being greatest, and the sandy bottom exposed to its action) it continues to work, at a time when it can work to the best advantage: and when the ordinary current of the river is assisted by extraordinary land floods and freshes, from downfalls of rain and snow (and this operating at low water, when as just remarked, the fall is the greatest), in such cases it is capable of producing extraordinary effects, and of keeping an harbour continually open (with a channel of given magnitude) though loaded with sands in any possible degree; for a fresh water river has this peculiar advantage, that at the same time that it strengthens the scouring power of the ebb, and operates most forcibly at low water (when there is the least to obstruct its operation) it opposes the tide of flood from the sea, and thereby prevents it from bringing so much sand and silt into the harbour as otherwise it would.

The defect, therefore, of this sluice of Wells is that though it retains the waters so as to be behind the general ebb, and thereby strengthens the latter part of it considerably; yet, being at low water all spent (when the greatest good might otherwise be obtained) it looses that good effect which would be had from a fresh water river, or from a proper sluice; that is, one that will retain the water wholly till a proper time of tide, and by then letting it off in one collected body, is capable in a short space of time of producing marvellous effects. And yet, I should not expect such a sluice, either to clear the pool to the depth it had 50 years since, nor carry the outfall channel out to the north-west.

By sluices of this kind, which are the only expedient art has found that is comparable to a river, the greatest part of the sea ports of Flanders and Holland are kept open, under circumstances more unfavourable than those of the port of Wells, many of which sluices are built not only with great expense as to the useful part but with much magnificence, as relying upon the durable utility of their construction. Those of the Wells traders that have occasion to visit the port of Ostend, so much resorted to at the present time, will see a remarkable example thereof in the grand sluice of Ostend, re-erected in the year 1755.

The Slade then consisting of 47 acres or somewhat less, on account of the high grounds inclosed therewith, as appears to me, might derive some occasional advantage in respect of scouring, from the very circumstance of their situation laying behind the ancient embankment; insomuch, that what is alleged by some of the witnesses, may at some particular time or times be true, viz., that when the tide was spent at the town it came down from the slade.

It seems well attested, and from the nature of the thing (as it appeared on my view) must be the case, that the surface of the slade never used to be overflowed, but in extreme spring-tides, here called rages, and the condition of it in growing rushes and other vegetables peculiar to fenny fresh waters before its embankment, shows this to be the general case. And this would naturally and necessarily arise from the very con-

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tracted channel, and opening left between the north-east bank of the ancient embankment and the high land; so narrow, that it does not appear that except at such times, there would be sufficiency of time at high water for the whole surface of the Slade, considered as a pond to fill at high water anything near the utmost height of the sea. But yet, whatever water was at such times brought upon it, would upon the same principle as the sluice be left behind, and retained by the same narrow passages, so as to require possibly the whole of the succeeding low water entirely to vend it; but then it will follow, that by how much it was the longer in vending, it would come down the more leisurely, and towards the latter part of it the more dribbling in proportion as its channel grew more contracted, by the surface of the water being lower therein; so that although it might at those times come down in good quantity in the first quarter's ebb, and (meeting the remains of the waters from the 16 acres of Slade marsh, and other waters from the unembanked marshes that still fall into the haven creek without passing the sluice) might make a sensible increase of the current; yet as this must greatly fall off, after the top waters were gone, that it could give but little aid in the latter part of the ebb (when it was most wanted) must appear equally clean and clear; but yet, whatever good effect might be ascribed to the water from the slade, or in reality it might have, when it could operate in the manner I have pointed out; yet, as it appears from equal testimony that those rages happen but seldom (four or five times in a year), they could yet be of no material benefit; because their power of scouring and grinding the bottom (in as much as the sea is incessantly bringing in a fresh accession of sand, silt, and mud), must be in proportion to their frequency; so that if it was to be supposed (what it does not appear to me reasonable to admit) that the effects of the Slade waters were, when they happened, even equal with that of the sluice; yet the sluice, if we lay the neap-tides out of the account, operating 365 good tides in a year, and those but five, the benefit could only be 70 to one, an effect so small that when mixed with many others could not be perceived; and though in the eye of reason, everything that operates at all must have an effect, yet it clearly appears to me, that the effect to be expected either by a shutting up, or the opening those marshes in the manner they were before the embankment in 1758,* could procure no such beneficial effect upon the harbour, as to prevent the necessity of supporting and continuing the sluice, or even to be of any measurable or estimable degree of value, and that this explanation of the small utility to be derived or expected from the Slade marsh waters is in reality the true one, is proved by the facts already stated, viz., that before the year 1738, they had proved totally ineffectual, and had always so proved ever since, whenever the sluice was out of order. I must, therefore, conclude in the sentiment of Mr. Mylne, that whoever would find a cause for the alteration of the course of the out channel, for the filling up of the pool, for the landing up of the harbour, channel, or creek, and in general for the decaying state of the harbour of Wells, must seek some cause widely different from the embankment of the Slade marshes in the year 1758, and the remedy from human industry and art in something more powerful, and better adapted than any of the sluices already constructed appear to have been.

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No. 231.

Resolution of the Commissioners to permit a Reservoir to be cut in the Warham Slade Marsh.

Resolution of the Commissioners to permit a Reservoir to be cut in the Warham Slade Marsh.

(Copy.)

AT a Special Meeting of the Commissioners and Trustees, held at the Fleece Inn in Wells, on Friday the 29th day of January, 1808,

THOMAS WILLIAM COKE, Esq. stated to the meeting that having observed the great solicitude of the Commissioners for the accumulation of back-water to scour the harbour, and being desirous of furthering their views in this respect, as far as lay in his power, he had turned his attention to the Warham Slade Marsh, and had formed a project for improvement in that quarter, which, as combining mutual advantages, he conceived would meet the approbation of the Commissioners.

Mr. COKE proposed to cut a reservoir or canal in the said Marsh, of such dimensions and in such a situation as shall be agreed upon, which shall freely admit the tide waters in larger quantities than the Marsh in its present state is wont to receive, and shall be itself cleansed by fresh waters collected from the marshes passing through it, and in return for this benefit to the harbour, that he shall be at liberty to erect a bank, so as to exclude the salt water from the other parts of the marsh; the whole to be done at the sole expense of Mr. Coke: and the sluice or sluices, which it may be thought proper to erect, to be also constructed and kept in repair at the expense of Mr. Coke.

The Commissioners proceeded to take the said proposal into consideration, and it appearing to them,

1st. That the improvement of the Marsh suggested, as it regards the converting it from a state of mere waste ground to a productive condition, is desirable, because with individual advantage it connects in some degree that of the public.

2nd. That for a long time past the utility of the said Marsh, as a receptacle for back-water, has been very inconsiderable, it being now ascertained that the water in common spring tides does not run to the level of its surface, and that the Marsh is in reality never overflowed so as to send forth a body of efficient scouring water, unless in cases of forced or raging tides, which very rarely occur.

3rd. That the reservoir or canal proposed to be formed will, as to situation, possess all the advantages which can be desired from the Warham Slade, and will be in the very spot which the different engineers, who have at different times been employed to survey the harbour, have represented as the best adapted for a receptacle for back-water; and will have this great superiority over the Slade in its present state, that it will several times in each fortnight return a powerful body of back-water to assist in cleansing the harbour, whereas the Slade is now very seldom in a condition to render any service at all in this respect.

Resolved. That this meeting entirely approve of the proposition offered by Mr. Coke, and fully acquiesce in and consent to the execution of the measure, upon the condition that an additional quantity of back-water, not less than five thousand tons, be thereby gained for the benefit of the harbour.

(Signed)	WM. STOUGHTON,	NICL. TICKLING,
	SAML. MADDON,	JOHN BLOOM,
	HENRY WALKER,	EDWARD OXENBOROUGH.
	GEO. TICKLING,	JOS. HAYCOCK,
	ROB. HAYCOCK,	JAS. GARDNER BLOOM,
	VAL. D. BRETT,	W. S. KIT,
	THOS. HARRISON,	JOHN RACE,
	THOS. BLOOM,	JOHN SEEL.
	THOS. WRIGHT,	

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* I say in the manner they were before the year 1758, that is when there was no bank at all; because if a partial breach was made in the bank, the waters issuing through this breach, would have an affect similar to the sluice, till worn by the entering and issuing waters, too wide to produce the effect; as was the case when Freestone's sluice was worn too wide, it ceased to do its duty.

APPENDIX B.

WALLS.

No. 232.

Rennie's Report and Plan for the Improvement of the Outfall to Sea through Moreton's Leam Wash and Wisbeach.

No. 232.

Mr. RENNIE's *Report and Plan for the Improvement of the Outfall to Sea through Moreton's Leam Wash and Wisbech; and for the Drainage of the North Level, South Holland, and the Low Lands adjacent, with Estimates: Directed to the Governor, Bailiffs, and Conservators of the Bedford Level Corporation.*

London, 26*th January*, 1814.

IN my Report on a plan for the drainage of South Holland, dated the 28th of January last, and addressed to His Grace the Duke of Somerset, I submitted an idea that the main drain proposed for discharging the waters from South Holland into the sea at Crabhole, afforded a fit opportunity of obtaining a much better outfall for the waters of the North Level than Gunthorpe Sluice, to which I might have added that of Borough Fen and Wisbech Hundred. In consequence of this idea the Honourable Corporation of the Bedford Level directed, in their resolution of the 9th of March following, that I should report my opinion on this subject, connected with the Wisbech Outfall, which they had by a former resolution directed me to examine and report upon. The idea mentioned in my Report on the drainage of South Holland, being by this resolution greatly extended, and some proprietors of the North Level being desirous that a scheme should be laid down for the complete drainage of that district, it became necessary to have the surveys, which before had been limited to the Wisbech Outfall, and the drainage of the extensive washes lying between the banks of the two branches of the Nene, extended to the North Level, which required a considerable time to accomplish; and it was not until the 24th ultimo that these surveys, plans, and sections were completed and put into my hands: from which it will appear that what I then predicted has been fully confirmed by the result of these surveys, plans, and sections. But as the general scheme is of an extensive kind, it will be best explained by stating the scheme for the drainage of South Holland, the North Level, Borough Fen, and Wisbech Hundred, separately from that of the Wisbech Outfall, and Moreton's Leam Wash.

When the drainage of South Holland was alone the subject of consideration, the scheme for this purpose was detailed in my Report to His Grace the Duke of Somerset, of the 28th of January, 1813. It was then proposed that a sluice of 36 feet waterway should be erected at or near the place where the Lutton Leam Sluice now stands, having its cill at least 4 feet under the level of the cill of the present sluice; and that from this sluice to a little above Burlieu Bridge, the present drain of Lutton Leam was to be straightened, deepened, and enlarged to a 36 feet bottom at the new intended sluice, and to diminish gradually to a 32 feet bottom at Burlieu Bridge. From thence I proposed a new drain to be made to join the drain called Bender Slough, at Almond's Bridge, and this drain to be widened, deepened, and enlarged to its junction with the South Holland drain, at which junction I proposed the bottom to be 30 feet wide. By means of the drain and sluice I have described, the whole of the low lands included in the South Holland district would have been completely drained, as the extremity of the main drain was not more than 16 miles distant from this new proposed outfall, and the lowest lands only about 11 or 12 miles distant, the surface of which is about 5 feet above the level of the present cill of Lutton Sluice, and as the cill of the new sluice was proposed to be laid at least 4 feet lower, this would give a fall of about 4 inches per mile in the bottom of the drain, which I deemed sufficient for the complete drainage of these lands. But the land in Morris Fen being only 2½ feet above the level of the sill of the present sluice at Lutton Leam, while it lies at the distance of 21 miles from it; and as there are other lands in the North Level even lower than Morris Fen; it is quite clear that if the sill of the new sluice is only laid 4 feet deeper than the present, although it would give sufficient drainage to the low lands in South Holland, which lie only 11 or 12 miles distant, and are 5 feet higher than the cill, it would by no means suffice for the low lands in the North Level, unless the drain was to be made of an extraordinary size; for after allowing for a moderate depth of drain, and for the water to be kept 2 feet under the surface of these low lands, there would not be more fall in the drain than 1½ inch per mile, and it would be less in Borough Fen, where the distance is several miles greater. To effect therefore the complete drainage of the low lands in the North Level and in Borough Fen, a much greater declivity ought to be procured if possible; and, fortunately, this can be effected in the bottom of the drain, as it appears from the levels taken by Mr. Bower (who was employed by me for that purpose), that the ordinary spring tides in Crabhole ebb, 9½ feet below the level of the cill of the Lutton Leam Sluice, and therefore admit of the cill of a new sluice being laid so much deeper than the present sluice. This will give a fall in the bottom of a drain from the low lands in the North Level of at least 4 inches per mile.

The declination of the Hobhole Drain near Boston, so far as relates to the East Fen, is 5 inches in a mile; but the East Fen, like South Holland, lies near to the outfall; and, therefore, although the bottom of the deeps is lower than the lands in the North Level, the declination I have stated is easily obtained, on account of their proximity to the outfall. But Wildmore Fen, which is also drained through Hobhole Sluice, lies at a greater distance from the outfall, and a part of it called No Man's Friend, is above a foot lower than any of the lands which Mr. Bower found in the course of his survey. The declination therefore of this part of the drain, is much less than that for the East Fen. The water from Hobhole Drain is discharged into the Witham, at the lower end of Wibberton road; and when there are large freshes in the river, the surface of the water on the outside of the sluice is frequently much higher than the level of Boston Deeps, and continues so for days together. This will not be the case at Crabhole, where the water has ample room to spread after it is discharged from the sluice, and therefore the declination I have named is amply sufficient to effect a complete drainage of all the lands comprehended within the district, and even much more if required. With the foregoing explanation, I will now proceed to state the scheme I propose for the drainage of South Holland, the North Level, Great Porsand, Borough Fen, and Wisbech Hundred:—

I propose that a sluice of 45 feet waterway shall be placed near where the present sluice of Lutton Leam stands, having its cill 9½ feet under the level of the said sluice, which is 5½ under the level of Denver Sluice, and 6 inches under that of Hobhole Sluice. From this sluice I propose the present Lutton Leam Drain to be deepened and enlarged to a little beyond Burlieu Bridge, and from thence a new drain to be made to the Shire Drain, at a place called Bird's House, crossing the South Holland Drain near Forman's Bridge. From Bird's House to Clow's Cross I propose the Shire Drain to be deepened and enlarged. From Clow's Cross to Gold's Dyke, the boundary of Thorney Fen, I propose one part to be a new drain, and the other part an increase of the New South Eau; and in like manner to enlarge and deepen the said Eau to Green Drove, and from this drove a new drain to be made to the extremity of the North Level at Catwater. Here the works for the drainage of the North Level itself terminate. But as the drainage of Borough Fen, is in as bad a state, nay, worse than the North Level, it seems highly necessary that this drain should be extended to the Peakirk Drain, and that the said Peakirk Drain should be deepened and enlarged to Low Drove in Borough Fen.

I propose the drain I have described to have a 40 feet bottom, from the new intended Lutton Sluice to the place where it crosses the South Holland Drain, and at this place to be reduced to 30 feet, and from thence to diminish gradually to a 27 feet bottom at Clow's Cross. From Clow's Cross, it is intended to diminish gradually to a 21 feet bottom at Low Drove in Borough Fen, where it is intended to terminate. The total length of this drain will be about 24 miles, and the fall from the surface of the land in Low Drove, Borough Fen, to the sill of the new intended sluice is nearly 14 feet, a fall quite sufficient to lay all the land in the great extent of district through which it passes completely dry, provided the ditches and drains communicating with it are kept in a proper state. And therefore all the windmills in the North

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Level, in Great Porsand, and Borough Fen, will become unnecessary; whereby a large annual expense will be saved to the proprietors, while the land by being constantly kept dry will be greatly improved in value.

The expense of the works I have described will be considerable, amounting, as appears by the estimate, to no less than 263,604*l.* But this sum, although large, is very moderate when compared with the immense district of land which will be completely drained by it, amounting to upwards of 80,000 acres. And I apprehend that when the expense of building, working, and repairing the windmills now required to keep the land in little better than a half-drained state is considered, it will be found that this sum does not very much exceed the present expense of windmill drainage; so that the principal part of the benefit which will arise from the improvement of the land, will be a clear gain to the owners and occupiers.

Having now detailed the outlines of my plan for the drainage of South Holland, the North Level, Great Porsand, and Borough Fen, to which I may add Wisbech Hundred, as that district will be drained by discharging its waters into the Shire Drain; I will next proceed to state my opinion respecting the Wisbech Outfall, and the drainage of the washes lying between the banks of Morton's Leam. And this subject, though easily effected in point of principle, is attended with much difficulty on account of the Nene passing through the town of Wisbech, where the channel is so narrow, and the buildings so close to the river, that there is not room to widen and deepen the channel sufficiently, to make it capable of discharging the freshes of the Nene. Consequently, unless a considerable number of houses are taken down, and even the bridge itself, very little can be done in the channel of the river. The outfall of the river below Gunthorpe Sluice is also in a bad state, owing to the extensive sands which lie between this place and low water at Crabhole, and which sand occasions the channel of the river to be very crooked, and to change its course frequently.

When Mr. Bower's levels were taken in November last, there was a fall at low water from Sutton Wash to Crabhole, a distance of something less than four miles of 12 feet; from the surface of the water at South Holland Sluice to Crabhole, a distance of four miles and a half, 12 feet 7 inches; and from the surface of the water at Gunthorpe Sluice to Crabhole, a distance of about five miles and a half, a fall of about 13 feet; and from Wisbech Bridge to the same point, a distance of 11¼ miles, a fall of 13 feet 6 inches.

From Guyhirne Ferry to Crabhole, a distance of near 17 miles, there was a fall of 14 feet 6 inches; and from Peterborough Bridge to the same point, a distance of about 30½ miles, a fall of 18 feet 6 inches; so that from Sutton Wash to Crabhole, there was a fall of 3 feet in a mile; whereas from Peterborough Bridge to Sutton Wash, a distance of more than 26 miles, the fall was only 6½ feet, which is only 3½ inches per mile on the average; but at the intermediate distances between Sutton Wash, South Holland Sluice, and Gunthorpe Sluice, the fall per mile is nearly double the above average, and of course from Peterborough to Wisbech it is less than the average.

From the facts I have stated, it is therefore evident that the great bar to the discharge of the waters of the Nene, and of course to the general drainage of the lands depending on this river, is the high and shifting sands which lie between Gunthorpe Sluice and Crabhole, and the narrow and confined channel of the river through the town of Wisbech. The question then is, How are these two obstacles to be removed? To answer this question, it does not seem necessary to give an account of the various plans which have been proposed for this purpose by Mr. Smeaton, and many other able engineers who have written on this subject. The levels prove so incontestably where the obstructions lie, that little reasoning is required. If the outfall of the Nene is to be effectually improved, it must be by a new channel from the mouth of Kinderley's Cut at Gunthorpe Sluice, to the level of the low water in the bay at some place or other; and no place seems so eligible, both in point of distance and depth of water, as Crabhole, near where the water from Lutton Leam is now discharged. This cut, however, may either be made without the present bank or within it. The latter I prefer; because, if made without the bank, the sands are so light and liable to shift, that a suitable channel for the river could not be made and maintained at any reasonable expense; whereas within the bank, although the expense will be great, it is much easier to be calculated, and more certain in the execution. I therefore propose, that a new channel should be made for the outfall of the Nene from the low water at Crabhole, to the mouth of Kinderley's Cut, having a bottom of 50 feet wide, and slopes on each side of four horizontal to one perpendicular.

From the mouth of Kinderley's Cut to the Horse Shoe below Wisbech, I propose the old channel to be enlarged to the same width of bottom as the new cut below; but owing to the bridge at Wisbech, and the houses being built so close to the river, a channel, if dug to the proper depth, cannot be made to have a wider bottom through the town than 18 feet (unless a number of houses were to be pulled down), and it consequently would be too narrow to carry off the floods of the Nene. To avoid this, it has been proposed by several people, that the channel through Wisbech should be enlarged as much as the bridge and buildings will admit, and that a new cut should be made from the Horse Shoe, in a straight line to Rumer's Mill, of a sufficient capacity to take the flood waters, having a sluice placed at its upper end, to be used only when the floods are larger than the narrow channel through Wisbech will take away. This is, no doubt, a very rational and sensible plan; but, I fear, if executed on the above principle, it will be a more extensive and less effectual one than may be generally imagined; for, in the first place, whatever mud, sand, and silt is deposited by the tide in the narrow confined channel through Wisbech, will there remain unless scoured away by the freshes of the Nene, which by this plan are intended to be turned down the new intended channel. The mud will therefore remain in the old channel through Wisbech, a distance of nearly four miles to a certain extent, and to keep this within bounds, the sluice on the new cut will not be opened except in large freshes (which is the only time the water is capable of scouring this mud away). Then to save the banks above, it is to be opened, and the water let down the new channel, while in moderate freshes it is to be kept in the old channel, and by this means to be penned up between Wisbech and Peterborough. No material advantage can therefore be gained in the way of drainage to the Wash and the Middle Level by this plan, unless the freshes, large and small, are allowed to have a free passage to sea.

Secondly, The new intended straight cut between the Horse Shoe Reach and Rumer's Mill will silt up at those times, when the river waters are sent through Wisbech, unless prevented by a sluice at the lower end to keep out the tide water; and even with this, by the water being stagnant it will grow full of weeds, or unless a sluice were to be placed at the lower end of the outfall by Lutton Sluice, to shut the tide entirely out of the whole, by which this new channel, as well as the old from Rumer's Mill through Wisbech to the Horse Shoe, and indeed the whole river, would be kept nearly clear from silt; and if a lock was to be placed on one side of the sluice, vessels would be enabled to navigate from thence to and from Wisbech at all times, and the old channel from the Horse Shoe to the town, might have its bottom 30 feet for the sake of the navigation. The tide water might be let into this new channel when it was clear, and little impregnated with silt; by which, and the scour of the river and drainage water from South Holland and the North Level, a sufficient depth would be preserved at Crabhole for coasting vessels to come at spring or neap tides, whenever the wind and weather suited. From Rumer's Mill to Guyhirne, I propose a cut to be made near the middle of the wash in as straight a line as the banks will admit, and which cut will be partly in the present channel of the river, and partly out of it. From Guyhirne to near Peterborough, I propose in like manner, a cut to be made nearly in the line of the North Leam, but deviating in some places from it to make it straighter, and to admit of sufficient forelands for the north bank of the river. The earth which comes out of this cut will not only form a new bank on the south side of it to defend the great wash, which by this plan will all be on one side, but will afford a sufficient quantity to strengthen the other bank for the defence

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of the North Level. I propose the above cut to have a bottom of 40 feet wide, with slopes on each side, as three horizontal to one perpendicular, and that there shall be forelands of 50 feet wide on each side, between the foot of the banks and the slopes of the cut. The annexed estimate has been made on this supposition, and that a sluice is to be constructed at the mouth of the cut at Crabhole, and in which it appears that the total cost of this scheme will amount to *373,713l.* This sum, no doubt, is a very large one. But whether the tide is shut entirely out of the new intended cut by a sluice near Crabhole, or whether it is allowed to flow up this new channel, and a sluice placed at the mouth of the new cut by the Horse Shoe, I apprehend the expense will not be less than I have stated; for if the tide is admitted, the channel should be of larger capacity at its entrance, and it will require to be secured in the sides to prevent the silt from running down. The expense attending these will be fully equal to that of a sluice and lock at the entrance. Whichever of the plans I have stated is adopted, the great washes lying between the banks of Moreton's Leam, amounting to about 3,500 acres, will be completely drained, and the freshes which now descend from the uplands through Peterborough Bridge will be carried to sea without endangering the banks; and an extent of fen, not less than 100,000 acres, lying on both sides, will in future be secured from the immense and repeated losses which the breaches of the banks of Moreton's Leam Wash have from time to time occasioned.

As to the lands lying on the north side of the Nene, they will be sufficiently drained by the scheme I have before described for the North Level, South Holland, &c.; and as the lands in the middle level of the fen now drain to the Ouse, it will become a question, how far it may be advisable to take the benefit of the new or improved river, to ascertain the extent, which I am inclined to think they ought to do, unless the scheme of an improved drainage by the Ouse shall be carried into execution. The land without the washes lying generally from 3 to 4 feet lower than the washes, will not be drained through Moreton's Leam while land freshes are in the river; but if Moreton's Leam, or the Wisbech river, are used for a part of the Middle Level, as far as the height of the freshes will admit; and if a large tunnel or syphon aqueduct were to be made under it, to carry a part of the water in the Middle Level into the drain on the north side, great relief would frequently be afforded to the low lands in the Middle Level, at times when they cannot drain by their present outfall. A power of this sort, if exercised properly, would produce much good; and certainly if these lands in the Middle Level cannot obtain the drainage so necessary to their fertility by their own regular channel or outfall, they ought not to be deprived of a drainage by such other means as they can obtain.

In forming the opinion which constitutes the result of what I have stated, that a perfect drainage without the aid of windmills or steam engines, and internal banks and works, may be obtained for all the fens and low grounds lying between the sea and the north side of the Nene, and for the extensive washes on Moreton's Leam, and for the Middle Level if necessary; I have the satisfaction of observing, that it is not matter of speculation or experiment, but of certainty, found by the effect of the works of drainage for the fens north of Boston, which have lately been executed, and which comprehend a district of at least 75,000 acres, all of which are now perfectly dry..

Having now laid down a general outline of the plan I propose for the Wisbech Outfall, and for the drainage of the North Level, Great Porsand, Borough Fen, South Holland, and Wisbech Hundred, the next question which arises is, generally, how money is to be raised for the performance of these works, and in what mode it shall be apportioned to the different districts which will be benefited by them.

With respect to the first, it appears to me that the wash land lying between the banks of Moreton's Leam, amounting as before stated, to about 3500 acres, the extensive districts of land now lying between the mouth of Kinderley's Cut and Crabhole, amounting to about 7457 acres, and which in a few years will be reclaimed from the sea, should jointly largely contribute to the expense of these works. The money annually expended on the banks of Moreton's Leam by the Middle and North Levels, should be applied to the expense of these works; and when they are done, the levels will in a great measure be relieved from this expense. A tax should also be laid on the improved navigation, and a tax on such lands of the Middle Level and elsewhere as will derive benefit from it.

As to the works proposed for the drainage of the North Level, &c., it appears to me a fund may be derived from the following sources; namely, from the tax which the land now pays for the windmill drainage in all the different districts, and for the expense of building and keeping these mills in repair. Secondly, from the proportional improvement which the respective lands will derive by a complete drainage of this sort, in preference to the imperfect drainage which they now have. Thirdly, from a small navigation tax, which will prove highly beneficial by passing through the heart of these lands, which are now situated at a considerable distance from any sea port. And lastly, in case any of the lands in the Middle Level should take the benefit of this drainage in the manner I have mentioned, they should contribute in a certain ratio to the whole expense.

Having thus pointed out what occurs to me as the general sources from which the funds to execute these works may be derived, it will be for those interested to consider, whether there are any other sources from which funds may be obtained, and apportion the expense according to the respective benefits which each district will derive.

JOHN RENNIE.

ESTIMATE of the probable Expense of the proposed Drain from the Sea at Crabhole, below Lutton Sluice, to the place where it is intended to cross the South Holland Drain, near Forman's Bridge, being in length from the Sluice to the South Holland Drain, about seven miles and a half.

	£.	s.
To cutting from the intended sluice to Crabhole, and banking at the sluice	9,362	0
To a new sluice of 45 feet waterway	18,500	0
To cutting from the above sluice to the crossing of the South Holland Drain, the bottom to be 40 feet wide, with slopes of 4 feet horizontal to 1 foot perpendicular, where the silt is, and 3½ to 1 where the ground is better. The forelands to be 30 feet wide on each side, and the earth to be laid in a proper form on the banks	83,361	0
One principal and four lesser road bridges	11,500	0
A steam-engine for pumping water from the works	10,000	0
Land cut and covered	16,850	0
Contingencies	29,915	0
	£179,488	0

ESTIMATE of the probable Expense from the crossing of the South Holland Drain near Forman's Bridge, to the Junction of the Shire Drain at Bird's House, being in length nearly two miles and a quarter.

	£.	s.
To cutting a drain having a 30 feet bottom, and slopes as three horizontal to one perpendicular	10,360	0
To a stop sluice and three road bridges	8,300	0
Land cut and covered	3,900	0
Contingencies	4,512	0
	£27,072	0

ESTIMATE of the probable Expense of scouring out and enlarging the Shire Drain from Bird's House, to Clow's Cross Sluice, being in length about five miles and a quarter.

	£.	s.
The drain to be 29 feet wide at bottom at Bird's House, and to diminish gradually to 27 feet at Clow's Cross; slopes to be three horizontal to one perpendicular	14,129	0
To a road bridge at Clow's Cross	1,500	0
Land cut and covered	4,680	0
Contingencies	4,062	0
	£24,371	0

ESTIMATE of the probable Expense of a Drain from Clow's Cross to Gold Dyke, part only being a new drain, and the length about two miles and 52 chains.

	£.	s.
The bottom of the drain to be 27 feet wide at Clow's Cross, and 25 at Gold Dyke	6,375	0
Land cut and covered	2,280	0
Contingencies	1,731	0
	£10,386	0

ESTIMATE of the probable Expense of enlarging the New South Eau from Gold Dyke to Green Drove, and from thence in a New Drain to Catwater, being in length five miles and 51 chains.

	£	s.
The bottom of the drain to be 25 feet wide at Gold Dyke, and 23 at Catwater; slopes to be three horizontal to one perpendicular	7,744	10
Four Bridges on ditto	2,000	0
Land cut and covered	3,000	0
Contingencies	2,548	10
	£15,293	0

ESTIMATE of the probable Expense of making a New Drain from Catwater to the Peakirk Drain, and enlarging the same to Low Drove in Borough Fen, being in length one mile and a quarter.

	£.	s.
The bottom of the drain to be 23 feet wide at Catwater, and 21 feet at Low Drove	1,509	12
A bridge over ditto	500	0
Land cut and covered	800	0
Contingencies	562	8
	£3,372	0
Cleansing the old Shire Drain, or South Eau, and repairing the bridges, &c.	£3,622	0

Recapitulation.

	£.	s.
Drain Sluice, &c., from Crabhole to the South Holland Drain at Forman's Bridge	179,488	0
Ditto from the South Holland Drain to Bird's House	27,072	0
Ditto from Bird's House to Clow's Cross	24,371	0
Ditto from Clow's Cross to Gold Dyke	10,386	0
Ditto from Gold Dyke to Catwater	15,293	0
Ditto to Low Drove in Borough Fen	3,372	0
Cleansing the Old South Eau	3,622	0
	£263,604	0

ESTIMATE of the probable Expense of making a New Cut for the Outfall of the Nene, from Crabhole to the lower end of Kinderley's Cut at Gunthorpe's Sluice, being a length of about five miles and three chains.

	£.	s.
The cut to have a 50 feet bottom, and slopes as four horizontal to one perpendicular, the earth work of which will amount to	98,146	1
A new sluice, 54 feet waterway, with a lock on one side of ditto for the navigation	24,000	0
To bridges and towing path	6,900	0
A steam engine for pumping water from the works	10,000	0
Land cut and covered	16,500	0
Contingencies	31,109	19
	£186,656	0
To cleansing and deepening the river from the lower end of Kinderley's Cut to the Horse Shoe below Wisbech, and making a towing path, length four miles and 66 chains	£44,544	0

ESTIMATE of the probable Expense of a New Cut from the Horse Shoe to the Nene at Rumer's Mill, being in length three miles and 23 chains.

	£.	s.
The cut to have a 40 feet bottom, and slopes as three horizontal to one perpendicular	18,565	0
Two turnpike and one occupation bridge, and a sluice at upper end of the cut	9,400	0
Land cut and covered	8,460	0
Contingencies	7,285	0
	£43,710	0
The probable expense of deepening the old river from Rumer's Mill through Wisbech to the Outwell Navigation, having an 18 feet bottom, and from thence to the Horse Shoe, having a 30 feet bottom, will be about	£12,000	0

ESTIMATE of the probable Expense of making a proper Channel for the River Nene from Rumer's Mill to Peterborough, being a length of 16 miles.

	£.	s.
The cut to have a bottom of 40 feet wide, slopes as three horizontal to one perpendicular, with strong banks well puddled, and forelands of 50 feet wide on each side for the floods	55,336	4
A bridge at the Dog in a Doublet	5,000	0
Land for cut and cover	12,000	0
Contingencies	14,467	0
	£86,803	4

Recapitulation.

	£.	s.
Cut from Gunthorpe Sluice to Crabhole	186,656	0
Deepening and enlarging the river to the Horse Shoe below Wisbech	44,544	0
Cut from ditto to Rumer's Mill	43,710	0
Deepening channel of river through Wisbech	12,000	0
New River from Rumer's Mill to Peterborough, including banks	86,803	0
	£373,713	0

No. 233.

Leak's Report on the Harbour.

No. 233.

The Report of BENJAMIN LEAK, *of Holt, in the County of Norfolk, Surveyor, upon a Survey and Examination of the Harbour of the Port of Wells next the Sea.*

SIR, *Holt,* 21*st May,* 1828.

I do myself the honour of addressing you, and the other Commissioners for the improvement of Wells Harbour, to lay before you a brief statement of the proceedings which I have lately taken upon the subject of the improvement of the harbour.

Having many years ago been informed, and having occasionally since heard a concurrent opinion, that the navigation of the outer harbour was inconvenient and uncertain under any wind, and under many winds wholly impracticable, in consequence of the channel and its mouth being driven considerably to the eastward, and perilous for the navigation of vessels either in going out or coming in, I took occasion, during the course of last spring to make particular inquries respecting it, and to take a view of the channels of the outer and inner harbour, with the view that in case it occurred to me that any material improvement could be made, I would lay my opinion before the Commissioners for the harbour; and, from the information which I then and have since obtained, I am of opinion that the channel of the outer harbour, instead of being allowed to continue in its present inconvenient course, might, at a moderate expense (moderate when the importance of the object to be attained is taken into consideration) be conducted and preserved in a north direction, and nearly in a straight line, to the outfall at the sea, which direction and line is acknowledged by those best acquainted with the subject to be the most desirable, and which will, I have no doubt, be the means of creating a channel to sea of several feet of water at low water, instead of its being, as now, about eighteen inches in depth. I have, therefore, considered it right to make proposals to the Commissioners for carrying into execution a plan which I thought advisable to have adopted for making the harbour easy of access and commodious; and upon the 16th instant I attended at a meeting of the Commissioners, by appointment, at the Fleece Inn, and delivered to them my report and proposals respecting the harbour, of which the following is a copy; and at the time I delivered the report and proposals I stated that, as the subject was an important one, I did not request nor expect an immediate answer, but advised that it should be considered and discussed, and a determination made at the next half-yearly meeting on the 2nd day of July, what was best to be done.

Copy of Report and Proposals to the Wells Harbour Commissioners, 1828.

"It appears by the evidence of the persons residing on the spot, and by ancient documents and records, that the harbour of the port of Wells next the sea has for many years, and particularly since the year 1670, been gradually shifting to the eastward by the current of the tides (between half-flood and half-ebb) setting over the sands in that direction, which renders it not only inconvenient at all times, but in many cases utterly impossible for vessels to enter the said port when most in need of a place of safety, either in gales of wind from the eastward or the westward; and it would be a great convenience, and a manifest advantage to those engaged in the coasting trade generally, and particularly to the trade of and in the port of Wells, by a material saving in property as well as the preservation of many valuable lives, that the channel northward of the Scolph Beacon to the outfall of the harbour of the said port, instead of its continuing in its present crooked, shallow, intricate, and dangerous course, should lie and be in nearly a north direction and nearly in a straight line, and that the waters ebbing from the salt marshes and inner harbour, should be allowed to pursue that course from the Scolph to the sea, and that the channel of the outer harbour should be assisted and protected in keeping such a course, and be in future prevented from being driven by the tide and the shifting of the sands to the eastward, by erecting a substantial pier or effectual barrier on the west side of the said harbour, and other works for that purpose, so as to form for the future a broad, deep, straight, and commodious channel for the navigation, and to give facility to and enable vessels to enter the said harbour when the wind blows from any point in that moiety of the compass towards the north, and to leave the said harbour when the wind blows from any point in that moiety of the compass towards the south, and that too either by night or by day. . . .

Erection of Works.

"That a substantial and efficient pier or barrier against the eastward set of the tide shall be raised and made on the west side of the outer harbour, so as to admit the flux and reflux of the tidal waters nearly in a north direction, and nearly in a straight line, to and from the present site or situation of the Scolph Beacon, from and to a certain point near low-water mark bearing from the said beacon about north, which point is proposed to be hereafter the mouth or outfall of the harbour.

"That sufficient works shall be raised and made northward of the pool, extending in a west direction from the sand hills in Wells called the Lodge Meals, across the place then called the Lows, so as to divert the course of the waters which now pass through the Lows to and from the pool, into, and compel them to pass along, the regular navigable channel.

"That a good and sufficient bank, equal in altitude to the tops of the spring tides, shall be raised and made, commencing at the east end of the sand-hills in Warham called the Meals, and extending across the salt marshes to the high-water mark on the south side thereof, near the cottage in Warham called the Shepherd's House, or in some other direction and site which shall be convenient and eligible, provided that such other direction and site shall encompass a space, as and for a reservoir for back water, equal in magnitude to the space contained on the west side of the bank, proposed to be made between the said east end of the said Meals and the said Shepherd's House.

Compensation.

"Contractor shall give security for the erection of the works. . . .

"Commissioners shall pay into the hands of a treasurer, on account of contractor, previously to raising the works, the sum of 500*l.*, and the further sum annually of 400*l.*, for the interest of such sum of money as may be expended in making the said works, and for the keeping of the same works in repair."

After reading the Report and Proposals, it was unanimously admitted that the proposed improvements were highly desirable, but that the income arising from the duties payable to the Commissioners was not sufficient to warrant their making an agreement for the erection of the proposed works; and it was ordered, that the subject should be taken into consideration, and a determination

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respecting it made, at the half-yearly meeting in July: and the Commissioners then adjourned their meeting to Thursday, the 20th May.

After the adjournment of the meeting of the 16th, I made inquiry concerning the amount of the income and expenditure under the Act of Parliament for the improvement of the harbour, and, from the information which I received, I was of opinion that the amount of receipts for the duties under the Act *was fully adequate* to defray the expenses of erecting and keeping in repair all the works which I propose to be constructed, and for paying every outgoing for keeping the harbour *in fine order*; I therefore considered it right to correct the error into which those gentlemen had fallen, and afford them requisite information thereon; and, at the adjourned meeting of the 20th, I presented to the Commissioners then present the following prospectus, viz.:—

"*Wells Harbour*, 1828.

"*Holt, May 20th*, 1828.

"Mr. Leak, in making the following Proposals and Tender to the Wells Harbour Commissioners, refers to the terms of the report and specification which he delivered to them on Friday, the 16th instant, and to their answer to him, 'That the proposed works were highly desirable, but that the income arising from the duties payable to the Commissioners was not sufficient to warrant their making an agreement for the erection of the proposed works.' Mr. Leak, therefore, tenders the Commissioners the following proposals, viz.:—

That he will place and keep in repair the works west of the outer harbour
That he will place and keep in repair the works north of the pool.
That he will place and keep in repair the bank across the marshes.
That he will expend one hundred pounds per annum upon the quays.
That he will pay interest of the five hundred pounds borrowed.
That he will pay the salaries of all officers.

"That he will keep the whole of the remainder of the harbour in repair, upon payment to him of four hundred pounds, and upon an assignment to him of the duties payable under the authority of the Act of Parliament for improving Wells Harbour.

"The above tender is to be binding only on condition, that the works upon the land subject to be flooded remain in their present state, and no new works commenced."

These Proposals were read by the Chairman, and ordered to be taken into consideration on the 2nd July, at the half-yearly meeting.

As I have considered it right, that each Commissioner should have an opportunity of considering the matter maturely, in order that he may be prepared to discuss the subject, preparatory to a determination being made upon it on the 2nd of July next, I have, therefore, caused a copy of this statement to be forwarded to each gentleman who is a Commissioner for that purpose.

I have, &c.,
BEN. LEAK.

No. 234.

Reports of J. M. RENDEL, C.E.

No. 234.

Rendel's Reports on the Harbour.

8, *Great George Street, Westminster, 5th December*, 1844.

AT the instance of Mr. Garwood I have had a survey made of the channel of Wells Harbour, from the Town Quays to the "West Meals," including those "Meals" to "Holkham Gap," or where they join the main land about 1½ miles west of Wells town.

The immediate object of this inquiry, as I understand, was to ascertain whether an embanked roadway could not be formed from the town to the entrance of the harbour, so as to make accessible at all times the extensive shore northward and eastward of the harbour's mouth, and to give a truer line of current to the flood and ebb tide in the harbour channel.

The accomplishment of these objects would, it was considered, confer such a *certain* amount of benefit on the harbour as to justify the exclusion of the tidal waters from the marshes and sand flats cut off; and it was thought that the value of the land so reclaimed would nearly, if not quite, equal the cost of the work.

In addition to the survey, therefore, I have caused a series of tidal observations to be made, to determine the rise and fall of spring and neap tides, and the times of low and high water, in different parts of the harbour, and generally have examined into other peculiarities of the estuary.

With this Report I have to submit a design for the proposed embankment, which would, I have no doubt, be practicable at the subjoined estimate; tend to keep the harbour channel, from the entrance of the Town Quays straight and clear of shoals; diminish the difference in the time of high water between the same points; and give an increased rise of tide at the Town Quay.

The loss of tidal water, in such a harbour as Wells, is certainly a matter for serious consideration. Upon the sufficiency of the scouring effects of the flood and ebb tide, the channels of such a harbour entirely depend. If, therefore, the quantity of water be diminished, and no increase of power obtained for what remains, such a diminution would be injurious; but my investigation convinces me that the advantages consequent on the proposed embankment in the more direct action of the tidal stream on the harbour channel, the increased perpendicular flow of the tide at the higher parts of the estuary, and the increased efficacy of the whole mass of water, would more than compensate the loss.

Now as to the quantity of water which would be excluded by the embankment, it appears that of the 580 acres of land so reclaimed, upwards of 250 acres are now salt marshes, only partially covered at high water of high spring tides; 230 acres are sandy plains, on an average one foot below high water of ordinary spring tides; and about 100 acres are of the same description, with channels covered on an average 2½ feet by similar tides.

Now these marshes, and the quantity of water which they contain, are small compared with those on the east side of the harbour channel, and which have the advantage also of a great extent of deep channel continuous from the main harbour channel. To diminish the area or capacity for tidal water over these eastern marshes would be most objectionable, but it is a question deserving of close investigation, whether an embankment, parallel with that shown on the accompanying design, commencing at the harbour's mouth, and continued to within, say 1000 feet of the town, would not be a work of the first importance in connexion with the embankment now proposed; and whether a sufficient portion of the highest and ripest salt marshes behind such embankment might not be reclaimed to defray the cost of the improvement, without an appreciable injury when contrasted with the benefit.

Such an embankment as here referred to would not of course be raised above the level of three-quarters flood of spring tides, excepting at the entrance, and where the land would be embanked; the object being to obtain, by means of two parallel banks, a stronger and truer run of tide between the harbour's mouth and the town, both upon the flood and ebb, leaving the lowest portion of the marshes, and the great low-water channels which traverse them, still exposed to the easterly gales which in high tides remove the deposits of sand which quiet weather permits to accumulate on their surface.

The advantage of the now proposed embankment in the facilities which it would afford for sending relief to the crews of vessels wrecked to the westward of Wells, is an adjunct benefit of too much importance to pass unnoticed.

I can give no opinion of the value of the land which the plan now recommended would reclaim. As before stated, the space westward of the embankment would be about 580 statute acres (as measured by Mr. Houghton), from which I think the tide might be excluded, even in that part of it which crosses the sands, by such a combination of chalk and silt, as would make the whole mass solid even whilst subsiding, should the sand waste in a way to admit of a settlement of the bank. The chalk can be obtained in any quantity from the high land just west of the town, and by a railway could be carried to and deposited in the embankment without risk and at a reasonable expense. The silt can be procured (of a good kind for the purpose) from the marshes, and the excavations would form a back drain for the embanked land.

It is reported to me that the sand hills, called the "West Meals," are a never failing protection from seaward, and my own experience of sand hills of this kind would justify that statement, assuming that proper care be taken to plant weak places with rushes in the common way.

The drainage of leakage through the bank, and of the rain-water, would of course have to be carried off through a properly-constructed sluice built in the embankment.

The general features of the proposed embankment, drain, &c. will be easily understood by the accompanying plans and sections. The details necessary for their execution shall be furnished when required.

The cost I estimate in the sum of 11,760*l.*

JAS. M. RENDEL.

8, *Great George Street*, *Westminster*, 6*th Feb.* 1845.

SIR,

Since the 14th and 15th ultimo, when by appointment I inspected Wells Harbour, and met you and the other Commissioners, I have given due consideration to the result of any survey, and to the information then elicited by an examination of sundry pilots belonging to the port, and have now the honour to submit a report on the several matters referred to me.

I would premise that, from their being no authentic old charts of the harbour, the important advantage of being able to reason on the future by the past changes that have taken place in the sea channels and bar is wanting. Though this is in some measure compensated by the intelligence of the pilots examined, whose recollection and experience go back for 30 years, yet the precise delineation and figured depths of the channel furnished by good charts, are far more important to the engineer, who is taught by daily experience the greater value of these most certain guides.

It appears, however, beyond a doubt, that since the year 1826-7, when the channel from the Meals to the town *was partially* straightened, and the *fleets in its east bank were closed*, a great improvement in its depths and ease of navigation has taken place; and further, that the plan which has since been adopted, of diverting *the course of the interior fleets*, so as to be filled and empteid along the face of the Town Quays, has also been attended with the best results, *from the additional scour thus produced* in the most important parts of the harbour.

This is the principle which should be followed in any future improvements; but, at the same time, great *caution is necessary in the practice so as to avoid any diminution in the area of these fleets, which are the vital parts in such harbours as this.*

In carrying out this plan, I should recommend, in the first place, a deposit of chalk as the cheapest material available along the east shore of the Harbour Channel, from the Meals to within 1000 feet of the Town Quays: this deposit should be in the form of an embankment, with such a slope as may be found from experience to stand the current without wasting.

By a reference to a copy, annexed, of my Report on the reclamation of the marshes on the west of the Harbour Channel, it will be seen that I consider the exclusion of the tide from these marshes more than compensated for by the advantages which the Harbour Channel would gain from giving the flood and ebb tide a true current through it. Now of course the embankment there recommended should be parallel with that now suggested on the east side of the channel, and the distance between the two should not exceed 800, or be less than 600 feet, according as may be ascertained on a detailed survey and a computation of all the fleets.

The expense of making a bank for reclaiming land is of course vastly greater than would attend a mere deposit of matter for confining a current of tide in a uniform channel, and, therefore, should the estimated cost of the work for reclaiming the Holkham Marshes prevent its prosecution, then I should advise a work on the west side, similar to that already proposed for the east side of the channel, with this only difference, that it should be continued quite up to the Town Quay.

Of course the current would produce the greatest effects on the Harbour Channel if these banks were raised above high water, but this is not necessary. If as high as three-quarter tide, it would be productive of great benefit to the channel, and would remove the strong indraught over Holkham Sands, which is now so troublesome to vessels entering the harbour, in southerly and easterly winds in spring tides. It would not be prudent to continue the west bank beyond the South Fleet till it could be raised above high water, and it would be necessary to give a free vent to the ebb tide waters from within it. But the great increase of deposits of sand, &c., which would follow such a limited embankment would soon raise the whole space to the level of high water, and make more easy the work of recovering these marshes, and the formation of a road from the Town to the West Meals.

I have already said that I consider the maintenance of the fleets in every part of the East Marshes as of vital importance. On my survey, I observed a system of encroachment going on that is more dangerous to their existence than an open attack,—I allude to the plan of closing up the mouths of the small fleets, which feed them with the water that covers the surface of the marshes in high tides. I

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know from experience that to the rush of water from the great area of the marshes by these secondary fleets the principal fleets owe the maintenance of their depth and capacity for back water. It appears that high tides flow over the thousands of acres of marshes traversed by the fleets, to a height of two, three, and sometimes four feet. Now, as the water ebbs out of the principal fleets and Harbour Channel much more rapidly than from the surface of the marshes, the consequence is that every one of the secondary fleets becomes a cataract, down which the water rushes into the principal fleets, and by that means they are scoured. This process of nature, so efficient for their maintenance, should be encouraged instead of being retarded, and I would suggest that the Harbour Master should be required to make at least two perambulations a-year for the whole extent of the fleets, and report any incroachments, that they may be immediately removed.

With reference to the sea channels and bar, I have strongly to urge the importance of encouraging the growth of the *Muscle Scalp*, which is now showing itself from the East Meals seaward. The growth of this bank, in height and solidity, is all important, as fixing the sands and confining the current of tide to one course. Its formation may be regarded as a most fortunate natural embankment, and the Commissioners should not be induced by the consideration of present advantage to any class to allow of its disturbance by raking and gathering the muscles. If permitted to accumulate for a few years, the object would be answered, so far as the harbour is concerned, and the poor might then gather with impunity: now their operations are alike distructive to their own and the public interest.

To attempt any works without the Meals till, as before proposed, those more obviously useful within are effected, would, I think, be unwise. The funds which you have at your present disposal would be perfectly insufficient; and it is also more than probable that the inner works would be attended with benefit seaward, *by encouraging an increased quantity of tidal water into the higher fleets*, and then by augmenting the quantity passing off over the outer channel and bar at the last of the ebb, when its power to scour and deepen would be greatly increased.

Without having before me an accurate plan of the entire harbour, I could not furnish an estimate of the cost of the proposed works, or go more into detail as to their exact position and character of construction; and I cannot close this Report more to the advantage of the interest you watch over than by urging upon you in the strongest manner the necessity which I consider to exist for your at once ordering some competent marine surveyor to make such survey, and define upon it all the important facts which you have from year to year to observe, on fulfilment of the important trust reposed in you.

I have only further to remark, that I do not doubt the result of carrying into effect the work proposed would be the giving of two hours longer navigable water to and from the Town Quays an increased depth of at least four feet between the Meals and the town, and some considerable improvement in the maintenance of the sea channel.

I am &c.,
JAS. M. RENDEL.

No. 235.

No. 235.

Correspondence relative to, and Returns of, Local Dues, 1843-44.

HONOURABLE SIRS,

Custom House, Wells, 7th May, 1845.

We submit herewith copy of our letter, dated the 5th instant, addressed to Mr. Southgate, the collector of the local dues at this port, agreeably with your honours' order of the 2nd instant above alluded to.

To this letter we have received Mr. Southgate's answer, herewith enclosed. We are unable to obtain any other explanation from that person, with reference to the report of the Beach officers.

W. DAWSON, *Collector*,
JAS. RODILLIARD, *Comptroller*.

To the Honourable Commissioners,
&c. &c.

(Copy.)

Custom House, Wells, Norfolk,
5th May, 1845.

SIR,

The honourable Board of Customs, by their order dated the 2nd instant, direct us to call upon you as the collector and receiver of the "local dues" at this port, for the under-mentioned return, viz., "An account of the total amount of the several dues and charges of every kind levied and collected on shipping, at the port of Wells, in each of the years 1843 and 1844; distinguishing the amount arising from each kind of charge, and separating the amount levied on foreign and British ships respectively." As this order is imperative, and requires our report forthwith, we trust you will enable us to transmit the return called for, or assign a sufficient reason for your non-compliance therewith officially.

We are, &c.,
(Signed) W. DAWSON, *Collector*,
JN. ROBILLIARD, *Comptroller*.

Joseph S. Southgate, Esq.
Collector of Local Dues, Wells.

MR. SOUTHGATE'S *Letter*.

GENTLEMEN,

Wells, 7th May, 1845.

In reply to yours of 5th instant, I beg to hand you the statement required, so far as I am able, of amount of dues received in the years 1843 and 1844, on all vessels entering the harbour of Wells.

	£.	*s.*	*d.*
For year 1843	530	16	6
1844	702	13	9

I am, &c.,
JOS. S. SOUTHGATE.

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No. 236.

Extract of Houghton's Letter on the Harbour.

No. 236.

Extract of a Letter from MR. EDWARD HOUGHTON, *Surveyor*.

SIR, *Wells, Nov.* 8, 1845.

I have ascertained with the greatest accuracy all the points you refer to relative to Wells Harbour, viz., the difference of level of low-water mark at Boat House shingle and Wells Quay wall is 5 feet 6 inches. The base of Boat House is 13 feet 4 inches above the level of low-water mark in the channel opposite. The high-water line in ordinary spring tides gives a flow at Wells Quay of 12 feet.

Having been engaged down the harbour three days previous, I observed the bar to be dry about 2 feet; therefore ordered a buoy to be placed by Robert Allen (a pilot) on the part of the bar which he would prefer bringing in a vessel the next tide; which was done, and next day I went with four men and boat and sounded the spot, and found 13 feet flow at high water. I also made arrangements to ascertain the exact flow at Wells Quay wall at high water, which was 8 feet 2 inches, making a difference of 4 feet 10 inches less water than over the bar. The wind on that day was full south, and a more sluggish tide I never saw, therefore the flow would be less than usual. I have a copy of the information which I believe was received by Mr. Rendel, reporting the tides, and it is as follows:—

New moon, August 14, at 32 minutes past 2 in the morning.

						ft.	in.	
Tuesday,	August	18, 1843,		high water	at Wells Quay,	13	0	flow. Wind N. W.
Friday,	,,	21,		,,	,,	7	6	(Dead of neaps).
Sunday,	,,	23,		,,	,,	9	6	
Monday,	,,	24,		,,	,,	10	0	
Wednesday	,,	26,	morning	,,	,,	12	0	
,,	,,	,,	evening	,,	,,	11	6	Wind N. E.
Thursday,	,,	27,	morning	,,	,,	12	0	flow.
Friday,	,,	28,	evening	,,	,,	11	4	Wind East.

The embankment made across the East Fleets in the year 1818 is raised sufficiently high to show 2 feet above high water flow in our largest spring tides.

No. 237.

Memorial of Merchants and others to the Tidal Harbour Commission.

No. 237.

The Memorial of the undersigned Shipowners, Merchants, Traders, and inhabitants of the Port of Wells-next-the-Sea, in the County of Norfolk, to the Tidal Harbours Commission.

SHOWETH,—That an Act of Parliament was passed, in the fifth year of the reign of his late Majesty King William the Fourth, for repairing, improving and preserving the Harbour and Quay of Wells; and that another Act was passed, in the seventh year of the reign of her eprsent Majesty, for improving the said harbour and quay, and extending and altering some of the provisions of the first-mentioned Act.

That, under the provisions of the said Act, the reparation, improvement, and preservation of the said harbour and quay are intrusted to Commissioners (named in the first-mentioned Act) and their survivors; and, in case of vacancies, the surviving or remaining Commissioners have the power to elect other persons to supply the same.

That the said Commissioners now consist of twenty-two persons, comprising noblemen, clergymen, medical practitioners, and only two nautical men.

That many of the said Commissioners reside at a great distance from the town, and are, therefore, unable to attend the meetings or execute the duties so intrusted to them.

That many of the Commissioners neither possess property in the town, nor are any ways interested in its prosperity.

That, at the recent inquiry, held at Wells, before one of the honourable Commissioners of Tidal Harbours (JOSEPH HUME, Esq., M.P.), it appeared that many of the items in the Commissioners' accounts were illegal; that gross mismanagement had prevailed; that great irregularities had occurred, not only in keeping of the accounts, but in the payment of large sums of money for the alleged purposes of the said Act; that one of the Commissioners held the offices of treasurer, secretary, collector, superintendent of steam tug and public works, and is deriving considerable profits from the said offices, and from the said works; that large sums of money had been expended extravagantly, and without consulting any practical engineer or experienced surveyor; that such sums had also been expended without public tender or contract.

That your memorialists believe that considerable sums have been improperly expended.

That, by reason of the heavy charges which now burden the shipowners of this port, they are unable successfully to compete with other ports; that the imports and exports, during the past year, have very considerably diminished from this cause; that the trade has been withdrawn from this port to a neighbouring port entirely on account of the heavy imposts to which, through the mismanagement of the Commissioners, the shipowners and traders are subjected.

Your memorialists, therefore, humbly and earnestly beg your honourable House to cause an investigation to be made into the grievances of which your memorialists complain; and in proof that your memorialist have not thus complained without sufficient grounds, they refer your honourable House to the evidence taken by Mr. Hume, at Wells, in October last.

And your memorialists will ever pray.

P.S.—The signatures to the original memorial, as presented to the Commission, embrace 13 merchants and shipowners, and 33 traders.

Appendix B.

Cley and Blakeney.

No. 238.

Evidence taken on the 28th Oct., 1845.

No. 238.

PORT OF CLEY AND BLAKENEY.

Examining Commissioner, Joseph Hume, Esq., M.P.]

Present:—Hardy Cozens Hardy, Randall Brereton, J. Lee, Esqrs.; Messrs. W. and C. Temple; Baines; P. P. Starling; T. Loads; Howard; Ramm; J. Muskett; J. Waller; E. Stirges; C. Cook; W. Pulleyne; R Bacon, *collector of customs at Cley*; and David Grieve, *comptroller*; W. Withers, Esq., of Holt; and several ship-masters, pilots, and others interested in the objects of this investigation.

Before the court was opened, the Commissioner, accompanied by several gentlemen acquainted with the locality, made a personal inspection of the embankments at Cley, and other portions of the navigation in that neighbourhood.

John May, glazier, 76 years of age, recollects when the Saltness, now forming Nos. 1 and 2 on the map, were inclosed. Appendix, see Map.

Mr. John Lee, merchant.—Came to Cley in 1820; has been a merchant ever since. At that time, vessels of nine feet draught could come up to the quay, where vessels of five feet only can come up now; this decrease in the depth of water is owing to the embankments thrown across the River Glaven and the Wiveton Marshes, in 1824; since that was done, the channel has become much narrower. Before that time there were four general merchants, now witness is the only one remaining; the expense of transhipment of all goods imported is very great in consequence of the deterioration of the harbour. Previous to the Cley embankment, he has seen the water from the sea running through the water-wheel at the mills at Glandford into the dam.

James Spooner.—Has been a pilot for 21 years; when first he was pilot, the bar had two feet more water than it has now; the west side of the entrance by the life-boat house was then quite "steep-to;" he used to round it close, and sometimes they used to land a man out of the vessel. The channel now shelves at the sides and is infested with sands; he could then come in with 17 or 19 feet at high water; he now has only 13 or 14; at that time he has known 140 sail take refuge in one tide; they used to lie in the pit afloat, where were then 10 or 11 feet at low water, now there are not more than three or four feet, and two vessels are the greatest number that could now be there. A W.N.W. was the worst wind when a vessel was coming in. Where they have been dredging, to make the new cut in Blakeney Channel, they manage to keep a depth. The harbour wants more back-water to improve it; the width of the channel to Cley has considerably decreased, and vessels cannot turn as they used to do.

The Commissioner inquired if any one kept a register of the tides?

Lieut. James Stewart, R.N., (Chief Officer of the Coast Guard,) said, that at Weyhoroe (five miles east of Cley) he found the springs rose 17 feet and the neaps 14.

The Commissioner inquired if there was any map of the harbour and lands adjoining, but none could be obtained.

Richard Mays, pilot, examined.—Concurred in the statement of Spooner; says that the channel has altered considerably since the life-boat house was built, about 26 years ago. The bar is a shifting bar, and constantly changing; recollects the outlet from the Cley channel to the Salthouse Broad on the east; it was closed up by the sea washing in the beach upon the mud; has seen 140 to 150 vessels taking refuge in the harbour; in the present state of the harbour and bar, four vessels cannot take refuge; there is now five hours' flood and six hours' ebb, but the last quarter ebb had no scour in it, as it used to have before the Cley embankment and sluice were put up.

Act of 2nd Geo.IV., Session 1821.

Mr. W. Withers, solicitor, of Holt.—Solicited the Wiveton and Cley Embankment Act, on behalf of Lord Calthorpe and others, the principal proprietors of the adjoining lands in the year 1820. In Cley parish, 96 acres, and in Wiveton, 142 acres, were inclosed under it.

Mr. Telford and Mr. Townshend, engineers, both recommended an open channel. Mr. Withers then read the following extracts from the Minutes of Mr. Dugmore, the Commissioner for the Wiveton Embankment Act:—

"*April* 17, 1822.—Some of the principal proprietors of estates in Cley and Wiveton met the Commissioner this day, for the purpose of taking into consideration the present state of the works which had been commenced at Cley and Wiveton in furtherance of the intended embankment and drainage; and after much discussion the proprietors present expressed a desire to have the works surveyed, and an estimate made of the expense of completing them. Whereupon Mr. Withers, the Clerk to the said Commissioner, received directions from him and the said proprietors to take a journey to Lynn, to see Mr. Townshend, a civil engineer residing there, and consult with him on the business, and request that Mr. Townshend would attend at Cley on an early day, and make a survey of the work already done, and state what further was, in his opinion, necessary to be done to complete the proposed embankment and drainage, and what further expense would attend the same, and make a report thereon to Mr. Withers for the information of the General Commissioner, and the parties interested in the measure."

"*July* 5, 1822.—At this sitting, Mr. Withers, junior, the clerk to the said Commissioner, stated that, in pursuance of the instructions he had received at the last sitting of the said Commissioner, he had waited upon Mr. Townshend, who had since taken a view of the works, and had made and transmitted his report thereon, which being read to the Commissioner and the proprietors present, they gave instructions to Mr. Withers to apply to the Loan Commissioners, to endeavour to obtain money from them for the purpose of completing the works and carrying the Act into execution."

Mr. Townshend's *Report*.

Mr. Townshend's Report.

"Dear Sir,

"*Lynn*, 28*th June*, 1822.

"I have examined the plan sent me by Mr. Leake, together with a Memorandum describing the intended works at Cley, and have also taken a view of the premises, but could not see the work forming part of the sluice, as the sluice-pit was nearly full of water.

"According to my estimate, it will cost about 3,300*l.* to complete the sluice, embankment, road, &c.; but in this sum there is nothing allowed for materials on hand. I don't mean any of those which have been made use of in that part of the work already executed, but such as have not yet been converted to any use, only prepared for the purpose.

"Some of the bricks laid down there are of a very inferior quality, and ought to be replaced with good ones; the rest of the materials (viz.) timber, stone, iron, &c., should be taken account of, and deducted from the above sum.

"I beg leave to observe, that I should wish to recommend several alterations in the plan, if it may be permitted: perhaps a less expensive sluice, on a better plan, might have been made in the first instance, and even now may still be improved, without increasing the expense, although a small part of the work would require to be taken up again.

"I am, &c.,
"THOMAS TOWNSHEND."

"*W. Withers, Junr., Esq., Holt.*

"*Nov.* 18, 1822.—The Right Honourable George Lord Calthorpe, John Winn Thomlinson, Esq., John Johnson Gay, Esq., Mr. William Buck, Mr. Thomas Cross, and others, proprietors of estates in Wiveton and Cley, were present at this sitting, and Mr. Withers, junior, the Clerk to the Commissioner, produced an account of the bills which had been contracted by Mr. Benjamin Leak, the surveyor under the Act, amounting to 1,391*l.* 12*s.* 1*d.*, which, with 171*l.* 11*s.* 5*d.*, that had been overdrawn at the bank, made 1,563*l.* 3*s.* 6*d.*, and it appearing that some of the parties to whom the money was owing had made many pressing and even threatening applications to the surveyor for payment, the proprietors agreed to join in a promissory note to the bankers for 1,700*l.*, who thereupon consented to advance money to discharge the above bills, and it was determined that such bills should before payment be examined by the surveyor and certified by him to be correct, and that the Clerk to the Commissioner should thereupon draw receipts for the amount, and that such receipts from the parties should be deposited at the bank.

"It was also determined that, as the expense of completing the works, according to Mr. Townshend's estimate, would amount to a considerable sum, that the Clerk to the Commissioner should apply to Mr. Telford, or some other engineer, to take a survey of the marshes and works, and make a report as to the propriety of going on with the present works, or of adopting some other plan for effecting the proposed embankment and drainage, and to make an estimate of the expense; and the Commissioner adjourned his sitting to the 13th day of March, 1823, to receive the engineer's report and estimate."

"*Mar.* 13, 1823.—At this sitting, the Commissioner directed his Clerk to prepare written instructions for Mr Telford, stating the object of his proposed survey, and the Commissioner desired a draft thereof to be laid before him for his perusal, at 10 o'clock to-morrow morning, to which time he adjourned his sitting."

"*Mar.* 14, 1823.—At this sitting, Mr. Withers produced to the said Commissioner, the draft of instructions for Mr. Telford, which the Commissioner approved and directed Mr. Withers to make a fair copy thereof, and deliver the same to Mr. Telford as soon as he arrived.

Instructions to Mr. Telford.

Instructions to Mr. Telford.

"Mr. Telford will please to take a survey of the marshes proposed to be embanked and drained, and of the works already commenced, and report as to the propriety of going on with the present works, or of adopting some other plan for effecting the proposed embankment and drainage, and to deliver an estimate of the expense. In determining upon the plan to be adopted, Mr. Telford will please to take into consideration the effect which it will have upon the harbour of Cley, any injury to which must be avoided, and the improvement thereof is an object, so far as it can be effected without any material addition to the expense."

"*March* 15, 1823.—At this sitting several of the principal proprietors were present, and Mr. Telford attended and produced his report in writing, which was taken into consideration by the proprietors, and after much discussion it was determined to postpone the further consideration thereof until the 10th of April next, and that a meeting of the proprietors should be convened on that day."

Mr. Telford's Report.

Mr. Telford's *Report.*

"Having this day examined the lands to be embanked and drained, accompanied by Messrs. Townshend and Leake, and having the plan hitherto pursued explained to me, and also the suggestions for embanking the present river, and having duly considered the same, having in view the effects to be produced in either case on the Harbour of Cley, I beg leave to state:—

"That from all the experience I have had of tidal rivers connected with drainage and navigation, I am convinced that both these objects are materially concerned in preserving a good outfall; and that this is to be most effectually obtained by suffering a free and full flux and reflux of tidal water as far as possible into the country; and I must add, that all other attempts, by means of sluices, have uniformly proved not only ineffectual but prejudicial.

"Under this conviction I am led to prefer embanking the present river to the mode of working by means of a sluice. This latter mode has not unfrequently misled engineers of considerable talents and experience, and has, in the present instance, been no doubt recommended with the most upright intentions; and it is with same regret I feel it my duty to advise a departure from it.

"From the best information I have been able to procure, I advise that a bank be constructed along each side of the river from the town of Cley to Glandford Mill, to be eight feet in height above the general surface of the marsh; to be three feet wide on the top, with a slope on the river side of two feet to one perpendicular, and one and a half to one on the land side, with a proper puddle wall and facing, turfed, and having a foreground of 10 feet. The river channel to be made 24 feet in width at the bottom, with a slope of two to one on each side.

"The quantity of land cut and covered by this mode would be about 25 acres; but of this the banks being about one-half would afford pasturage, and from the above land, cut and covered, there would be a sufficient quantity of turf procured to cover the new bank.

"The inclosed marsh on the eastern side might be drained either by means of the present creek, or small trunks into the river channel; the western either by a back drain, or similar trunks through the bank.

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"This mode, by connecting immediately with the uplands, affords opportunities for any mode of division judged most proper.

"In order to accommodate the road opposite the town of Cley, I propose having a wooden bridge upon the present river course of 50 feet opening, which would be an ample inlet to the new channel, which would be 24 feet at bottom and 52 at level of the line of the forelands.

"This ample flux and reflux of increased tidal-water channel, above the town of Cley, would compensate for the marsh land waters of which the channel will be deprived by embankment, and with the aid of occasional flood water would preserve the outfall below the town, which, I must repeat, is equally important to drainage and navigation.

"Of the materials now on hand, the timber and malleable iron only would be useful to the works here recommended; and having the use of these articles, the expense of the proposed scheme, executed in a substantial and workmanlike manner, will amount to 2,996*l.* 1*s.*

"THOS. TELFORD."

"*Holt*, 15*th March*, 1823."

"*April* 10, 1823.—At this sitting, Mr. John Smith, Civil Engineer, produced to the Commissioner proposals for embanking and draining the marshes upon a different plan to those recommended by Mr. Telford.

"SIR, "*Holt*, 10*th April*, 1823.

"I have surveyed the marshes at Cley and the line of embankment and sluice already began, and, taking other plans proposed into consideration, I find the present line may be followed and completed at less expense than embanking the river, and more than 20 acres of land saved at the same time. I beg leave to say I do not anticipate any advantages to the harbour of Cley by the plan of the sluice, but am of opinion it will be the means of accumulating an additional quantity of silt in the harbour. I have taken dimensions of the different parts of the work as they now stand, and find that the sum of 2,280*l.* will be required to complete them.

"Should this line of embanking be adopted, I recommend a cast-iron culvert of six feet diameter in the room of the present intended bridge and sluice; and having collected information respecting the expense of the castings, I find the present line of bank may be completed by a cast-iron culvert of the above dimensions for the sum of 2,040*l.* I have also surveyed the other line of embankment by the river to Glanford Mill, on which you have already received reports; and therefore I have to state the sum required to complete the works, by the plan recommended by Mr. Telford, as far as Wiveton Bridge and from thence to Glandford Mill, by one bank, which will cost 2,300*l.* taking the bridge and every part of the works into the calculation. I have now only to state that the materials are brought to account in each of the estimates herein given.

"JOHN SMITH."

"SIR, "*Holt*, 7*th March*, 1823.

"I HAVE again examined the works at Cley, and see no reason to alter my opinion with respect to the estimate for completing the same, but by now taking all the materials to account, it will leave the net amount 2,600*l.*

"I understand it is proposed, in order to guard against any injury to the harbour, to have three iron draw-doors, or paddles, on the land side, to hold up the tidal waters until the last half of ebb tide, and then to discharge the same through the sluice; if, however, the tidal waters should be muddy, it will settle in the bottom of the old channel, and in time this will become level with the marsh, and then, of course, that resource ceases; besides which, there will be an annual expense of a man to regulate the doors and paddles as well as the expense of keeping them and the machinery in repair. These matters, no doubt, may have been duly considered; but I beg leave to mention that it occurred to me on my first view, that if the work had not been so far proceeded in, I should have ventured to suggest an alteration for the consideration of the Commissioner and the gentlemen interested in this undertaking; and even now, finding the expense of completing the present works effectually to be considerable, as appears by the statement above-mentioned, I have turned my attention to a plan of embanking the river from Cley up the marshes to Glandford Mill, and still to make the intended road from Cley to Blakeney, in the direction already set out near Wiveton Hall, with a bridge over the river in the place where the sluice is erecting, and have made a survey and estimate of the same amounting to 2,850*l.*; but as the river runs near the foot of the highlands from Wiveton Church to the Mill, I should recommend the course of the old river there to be deserted, and a new cut made along the west side of the marsh: in which case one bank only would be required, and the expense perhaps reduced to less than that of completing the present works.

"I have only to observe that upon this plan, the sluice may be wholly dispensed with, and the trouble, risk, and expense of regulating it will be avoided, as the tide will have an uninterrupted flux and reflux to Glandford Mill; the effect of which will also in a great measure lessen, if not entirely remove, any apprehension of injury to the harbour of Cley.

"*Wm. Withers, Junr., Esq.*" "THOMAS TOWNSHEND."

"1823. *April* 10.—A meeting of the principal proprietors was held this day before the said Commissioner, when the several plans which had been recommended or proposed by the different engineers were taken into consideration, and it was finally determined that the works should be completed according to Mr. Leak's original plan; and the Commissioner received instructions from the proprietors to enter into a contract with Messrs. Drozier and Yell to complete the same for the sum of 1,410*l.*, according to a specification to be prepared by Mr. Leak and Mr. John Smith, engineer, under the superintendence of the latter of whom it was agreed the works should be carried on and completed.

"The following proprietors were present at this meeting, viz. :—

The Right Hon. GEORGE Lord CALTHORPE,
JOHN WINN THOMLINSON, Esq.,
Mr. WILLIAM BUCK,
Mr. JOHN TEMPLE,
Miss BOSCALL, by her agent, Mr. Platten,
Mr. WILLIAM FARTHING,
Mr. CORBETT COOKE, by the Rev. Robert Moore, his agent,
Mr. THOMAS JACKSON, by his son, John B. Jackson, and Mr. John Ram;

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"And on the question being put, Mr. Thomlinson and Miss Buscall only voted in favour of the adoption of Mr. Telford's plan, all the other proprietors voting for the completion of the works according to Mr. Leak's original plan."

Mr. WITHERS further stated, that although the whole of the land embanked (238 acres) was sold, the proceeds, 7,071*l.*, did not pay the expenses of obtaining and carrying out the Act, which amounted to 9,008*l.* And he furnished the following copy of the account of the proceeds of the sale of the lands, and of the expense of their embankment; viz.—

	A.	R.	P.	A.	R.	P.
1. Total quantity of land embanked and drained, viz.				238	1	39
Lands sold in Cley	70	2	3			
Residuary allotments in ditto	15	3	17			
Lands sold in Wiveton	105	3	15			
Residuary allotments in ditto	16	1	8			
Allotments to Special Commissioners (being banks, drains, water-courses, &c.)	29	3	36			
	238	1	39			

	£.	s.	d.	£.	s.	d.
2. The total expenses of obtaining the Act, and carrying the same into execution, amounted to				9,007	19	6
Which was raised as follows:—						
By sale of land	7,071	6	6			
By sums awarded by Commissioner to be paid by proprietors	975	11	3			
By supplementary rate on them	961	1	9			
	£9,007	19	6			

and showing a loss to the proprietors of 1,937*l.* by making the inclosure.

	A.	R.	P.
The land liable to be rated for ever for support of the embankments, &c., amounts to	164	1	15

and the following sums have been already raised by rate for that purpose:—

	£.	s.	d.	£.	s.	d.
1829	109	11	3			
1838	164	6	10½			
1841	54	15	7½			
				328	13	9

Mr. JOHN STARLING, Mr. HOWARD RAM, and Mr. JOHN WALLER, inhabitants of Cley, stated that at high-water ordinary springs those Wiveton marshes thus inclosed were formerly covered with two feet of water.

Mr. WALLER stated that Mr. Ball and Mr. Cook opposed the sluice, and that now, instead of the harbour having the benefit of the fresh water and a tidal channel 50 feet wide (as proposed by Mr. Telford), to be open at all times, they had a sluice of from 10 to 14 feet wide, which was nearly always closed; that the high tides of 1836 rose eight or nine feet above the level of the Wiveton Marshes that were inclosed in 1824.

Mr. BACON, the Collector of Customs, one of the oldest residents, stated, that he knew no other reason why Mr. Leak's plan had been adopted in preference to the other engineer's, except that it would save 25 acres of land, which the channel would have covered if it had been cut and embanked 50 feet wide, as proposed by Mr. Telford.

Mr. JOHN B. STARLING, shipowner, stated that he had seen, in a heavy gale of wind, the Wiveton Marshes, which were embanked in 1824, covered with six feet of water; at the same time there was at ordinary tides, before the sluice was put up, 13 feet water at the bridge above the harbour of Cley where the embankment now is, and now there is only from five to seven feet water at that place. All the marshes inclosed had one foot of water over them at high water. Had known the harbour since 1793; it used to be a common occurrence for as many as 120 or 130 vessels to take refuge in the Pit during a single tide. The Pit has filled up so much since the Cley inclosure, that there is no room for them now. The Salthouse Broad (540 acres), to the eastward, used to communicate with the harbour by an outlet, within the shingle beach, but the sea has forced the sand and shingle over, and closed it up.

Mr. HOWARD RAM, shipowner, stated that the Cley Channel, about 25 years ago, used to be three times as broad as it is now; thinks that there can be no doubt but that the embankment of the Wiveton Marshes has caused it to silt up. Recollects that there used to be a free passage for the tidal water in a channel from Salthouse Broad to a little below the town of Cley. A sluice has been erected on it for some years, which shuts out the tidal waters.

The COMMISSIONER inquired if any person could inform him what the present value of property in the town of Cley was, as compared to what it had been before the embankment was put up?

Messrs. LEE, STURGES, WITHERS and others, answered, that house property had decreased in value 33 per cent., granaries and warehouses upwards of 50 per cent., and that the town had generally declined; the Collector of Customs stated also that the revenue of customs had decreased. The meeting generally concurred in the decay of trade, and decrease of the value of property in the town, since 1824.

The COMMISSIONER then, at the request of the Blakeney Harbour proprietors, adjourned the Court to the Crown at Blakeney, in order separately to inspect and to inquire into the past and present state of that part of the harbour.

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The COMMISSIONER adjourned to the town of Blakeney, and having inspected the harbour, held an open Court, at which persons belonging to the town and port attended and gave evidence.

Mr. WM. PENTON, Harbour-Master.—Has been acquainted with the port for 65 years, and has sailed out of it as master mariner for 50 years; recollects that in 1790 Cley Channel used to have from eight to nine feet depth, up to the town, at high-water ordinary tides; there was then also a communication between the harbour and Salthouse Broad, which has since silted up; concurs generally in what has been previously stated at Cley of the deterioration of the harbour; recollects that there used to be always oysters and deep water in the "Pit," but since the Cley embankment in 1824 they had all left, in consequence of the sand having filled it up.

R. MAYS, pilot—States that on average spring tides, at high-water, there would be 17 feet on the bar, 16 feet in the "Pit," and 9 feet at the quay at Blakeny; in ordinary springs there was about 15 or 16 feet range of tide at the bar, and about 9 at the quay; had never known any vessel take harm by grounding when in the harbour.

Mr. JOHN STARLING confirmed the statement of the preceding witnesses as to the injury done to the harbour by the Cley embankment; recollects 140 sail entering the harbour in one tide; states that the entrance of the harbour had been carried bodily a quarter of a mile to the westward during his recollection, but that the bar had always been a shifting bar; there are now seven feet of sand in the Pit in some places, which has been washed in by the sea and the flood tide together; there was not sufficient scour now to take it out. In 1814 there was hard ground and oysters in the Pit, where the sands are now.

Mr. RANDLE BRERETON, merchant, stated that in the year 1817, an Act was obtained to improve the harbour of Blakeney and Cley, by making a direct cut of 500 yards, to shorten the channel from the quay; that the cut was made by a joint stock company, at the expense of 1,930*l.*; that there are 39 shares, at 50*l.* each, and the proprietors are entitled to receive the whole of the harbour dues, and a duty on exports and imports, not exceeding the rates specified in the schedules in the Act; that the directors are appointed by the shareholders out of their own number. The shareholders have power to appoint pilots.

The COMMISSIONER then examined the accounts of the harbour, from which it appeared that the receipts and expenditure for the last three years had been as follows:—

	Receipts.			Expenditure.		
	£	*s.*	*d.*	£	*s.*	*d.*
1842	464	1	10	129	17	4
1843	429	0	5½	204	10	3
1844	434	7	7	150	6	9
	£1,327	9	10	£484	14	4

The net dividends to the proprietors of the harbour for the same periods had been—

	£	*s.*	*d.*
In 1842	292	10	0
1843	241	5	10
1844	299	15	10
	£833	11	8

being on the average 14½ per cent. yearly.

There is no provision for paying off the loan, and the merchants and inhabitants of the port have no power to interfere.

Mr. RANDLE BRERETON further stated that an improvement had taken place in the depth of water in the Blakeney Channel and at the quay since the new cut had been made, and since the waters of the Agar Creek had been brought from the westward round by the quay; the Blakeney Harbour proprietors had obtained permission from the lord of the manor to place a dam across the former sea mouth of the Agar Creek, so that all the tidal water that goes into it now ebbs and flows through the Blakeney Channel and round by the quay; the piles of the Blakeney Quay are driven into chalk. That, in his opinion, one evident effect of the Cley embankment in 1824 was the great diminution of the quantity and strength of the last quarter of the ebb tide, and from the decreased strength of the current the entrance of the harbour had been gradually moved to the westward by the drift of the beach from the eastward more than a quarter of a mile, and the channel had been lengthened, and rendered so tortuous that it was more than a mile longer than before the inclosure. The channel had not only been partly filled up from the town of Cley, all the distance to its junction with the Blakeney channel; but beyond that the Pit itself had been almost entirely filled up by sand.

Mr. R. B. was also decidedly of opinion that, if nothing else could be done, the restoration of the Blakeney, Cley, and Wiveton Marshes would alone restore the harbour to its former depth, and to an efficient state as a harbour of refuge.

No. 239.

Extract from a Letter from Mr. WM. COOKE, *Miller, to* JOSEPH HUME, Esq., *Tidal Harbours Commissioner.*

No. 239.

Extract from a Letter from Mr. Wm. Cooke.

Glandford Mill, Blakeney, 3rd Nov. 1845.

In reply to yours of the 30th ult., I beg to state that the depth of water at Glandford Mill, in ordinary spring tides, before 1824, was from four to five feet. Our fall of water at the mill was six feet, and in high tides the current or tidal water has been known to pass through the water-wheel into, or to form a level with, the mill-dam. The highest tide I ever knew gave a depth of nine feet at Glandford Mill. John Baines, now master of a schooner belonging to us, was employed in a vessel trading to Cley, called the "Bell;" her draught of water was 7 ft. 3 in.; she was 54 feet long, and they could swing her at Cley Quay. I remember the "Carnline" of Cley, belonging to Mr. Arcber, merchant there, drawing eight feet water, the "John," a brig, drawing about the same, belonging to Corbet Cooke, merchant at Cley, besides other vessels occasionally trading there. My father was for many years in business with C. Conke, and I am able to state that he received for his share of the net profit

No. 239.

Extract from a Letter from Mr. Wm. Cooke.

an average of 10 per cent. per annum on his capital invested. The vessels employed were from 50 to 80 tons. Soon after the embankment, the trade decreased, and premises were offered to be sold or let without success; they have since been occupied at a loss.

I am of opinion that all the property in Cley, except land, has decreased 50 per cent. in value.

I cannot say with certainty whether I attended at the meeting when Mr. Telford was present; I saw him at Glandford Mill, and whether the remarks were made to me then and there, or reported to me by Mr. Thomlinson, the principal land-owner, I cannot be certain; but I can and do most positively state that the following remarks were made by Mr. Telford:—

"That the embankments at Cley would not only destroy Cley Harbour, but would throw up an obstruction or bar in Blakeney Harbour; and that he recommended an open channel to Glandford Mill, gradually widening in its course upwards from Cley Channel." And I well remember this principle being laid down in his remarks to me—"that wherever the tidal waters are unchecked in their influx a good outfall will be preserved."

I am not able to answer your question as to the time, or by what authority, the marshes east and west of Cley Channel were inclosed; but from that encroachment on the tidal waters I date primarily a great change in Blakeney and Cley Harbour, and the more recent embankment as completing the destruction.

Will you permit me to call your attention to Blakeney Harbour, once a harbour of refuge, and possessing, in my humble opinion, great natural advantages and facilities for saving life and property in shipping, in gales of wind from W.N.W. and north? I admit that much land is now affording fine pasturage over which the tide once flowed, but it has been at the expense of an awful sacrifice of ships and seamen. I need not remind you of the disasters on Sherringham Shoal, Hasbro' Sands, Cockle, Croby, and other sands, in ships running for shelter to Yarmouth Roads, &c., because they cannot find shelter on this part of the coast. Blakeney Harbour could once shelter 400 vessels; now our ablest pilots could not anchor 50 there.

WM. COOKE.

The following extract from the "General History of the County of Norfolk," shows its importance at former periods as a port:—

Extract from History of Norfolk.

Blakeney.—"It was in ancient days a famous sea-port, much frequented by the merchants of Germany. In the 9th of Richard II., when other mariners were impressed for the King's Service, the fishermen of Blakeney, Cley, and Cromer were excepted. Edward the II., in the third year of his reign, charged Blakeney with one ship of war, to be sent to Dublin to transport the troops round there to Scotland. In the 31st of Edward III., is a statute respecting the sale of fish, at a great fair held at Blakeney."

GREAT YARMOUTH.

No. 240.

Evidence taken on the 21st Oct., 1845.

No. 240.

GREAT YARMOUTH, NORFOLK.

Examining Commissioners—JOSEPH HUME, Esq., M.P.; Capt. WASHINGTON, R.N.

There were present also on the bench, in the Townhall, WILLIAM HENRY PALMER, Esq., *the Mayor of the borough*; and the following Commissioners under the Haven and Pier Act: R. MARSHAM, Esq., of Stratton Strawless, *Commissioner for Norfolk*; FREDERICK WILLIAM FARR, Esq., *Commissioner for Beccles*; GEORGE DANBY PALMER, Esq., and WILLIAM HAMMOND, Esq., *Commissioners for Great Yarmouth*; SAMUEL TOLVER, Esq., attended as *Clerk*; and JOHN EDWARD LACON, Esq., as *Treasurer to the Commissioners*; and the body of the Court full of inhabitants.

SPENCER SMYTH, commander R.N., examined.—I have been pier-master since 1835, and have had the general superintendence of the vessels which enter the port as far as Hardley Cross on the river Yare; and in the Breydon, to the mouths of the rivers Bure and Waveney; and I also superintend all improvements of the harbour and navigation. A steam-engine of 6-horse power, for dredging, has with the exception of a few months in the year, been constantly employed dredging under my orders; I carried on the improvements in the lower part of the harbour under Mr. Walker for the first two or three years. But Mr. Walker has not acted since 1837 or 1838; and there is no engineer now appointed under the Haven and Pier Commissioners.

Mr. SAMUEL TOLVER, clerk to the Commissioners.—Mr. Walker was appointed many years ago as the consulting engineer; he is still the consulting engineer: the only case in which his advice has been departed from was, in the case of the new bridge, which was the last subject upon which he made a report.

Capt. SMYTH resumed.—In 1836, the bed of the haven was in many places not more than five feet deep [a section of the river was handed by him to the Commissioners]; the whole of the inequalities in the lower part of the harbour have since that time been removed by dredging, and it has been made of the uniform depth of 8½ feet at low water from the middle of the town to the Brush; the quays on both sides of the channel down to the Brush have been dredged; all the projecting points have been removed. In 1836, the depth at the mouth of the harbour was 6½ feet at low water; but during the last two years it has been very steady at 8 feet; attributes the additional depth of water on the bar to the channel being dredged, and to the tide coming down in a more uniform manner; the greatest depth he has known at the bar has been 15 feet at high water, and vessels of that draught of water have come in during this year; such has not been the case for many years before.

Capt. MANBY, F.R.S., has known the bar for 42 years; never recollected the water at the bar deeper than at present.

Capt. SMYTH resumed.—The depth of water increases from 8 feet at the bar to 10 feet at the ordnance quay, and above that to the bridge to 15 feet generally. Mr Walker's recommendation to make the channel of an uniform width was carried out before I came; the width now is generally 270 or 280 feet, but in some places varies to 300 feet; the river widens above the Brush. The ebb runs about 2½ knots an hour in the middle of the haven; and at the entrance between the piers, as much as from 3 to 5 knots, but generally from 3 to 3½ knots; after heavy rains it runs 5, sometimes 6 knots; from high tides, such as occurred last night, there was very little ebb; the flood was rapid, I think 4 miles an hour to the Brush, and 6 miles through the bridge; the narrowness of the bridge increases the current in that part; I do not know why Mr. Walker's recommendation about widening the bridge was not carried out; I have received no instructions from the haven and pier commissioners to that effect; every work to make a change in that bridge has always been under the direction of a civil engineer; the difference in the height of the tide at the bar and at the bridge, during ordinary springs, is

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generally about 11 inches; in the high tide of last night, the difference was 2 feet 10 inches; I made the observations at the bar, and Mr. Burford took the height at the bridge. Mr. Walker's directions to take tide observations at the bridge have not been attended to lately; I have a register of the tides in the present year at the bridge, and at the pier; during the neap tides the difference in the level is generally about 7 or 8 inches at high water; on the 26th of January last there was a high tide; the height at the head of the pier was 3 feet 5 inches greater than that at the bridge. The number of vessels in the haven obstruct the flow of the tide; so does the narrownesss of the bridge: if the waterway at the bridge were increased, it would increase the flow, and there would be a greater rise and fall of the tide, which would affect the navigation upwards, and render the bottom of the haven and entrance deeper and more uniform, but the marshes above would in consequence be liable to be overflowed. The accommodation in the haven is not sufficient for the trade of this port, and to remedy this docks should be constructed, or the wharfs should be extended lower down the banks of the river. If the wind is to the northward, we are so crowded on the Brush that we are obliged to moor 5 or 6 vessels in a tier at that part; I have sometimes seen trifling, but never serious damage, arise from this crowding at the Brush; docks would remedy the crowding in a slight degree, but you could not get light vessels, which would want to go to sea, to go into them; a dock would certainly lessen the number of ships in the haven; the only spot that appears available for docks is the marsh on the west side of the river, between the Gorleston Cliff and the pier; it was enclosed in 1813, and belongs to Mr. Bell and other proprietors. I think the lower space that was awarded by the Enclosure Act to Col. Harvey would afford space to contain 50 or 60 sail: it contains about 4 acres, and that of Mr. Bell about 10 acres; this ground might be converted into a dock at less expense than any other part; there would be a few buildings to purchase, and some excavations to be made; very great accommodation would be afforded by extending the wharves downwards, on both sides of the haven, and there is nothing to prevent that being done but the expense. I am aware that applications have been made for accommodation to form wharves; the steamers are too long to lie across the river, and they take up a great deal of room lying lengthwise; a suitable dock might perhaps be made for them below the gas works on the east side of the harbour; we have not sufficient room at the town quays for the shipping of the port, and, in the lower part of the harbour, we are very much crowded. I have seen 1600 or 1700 vessels in Yarmouth Roads in bad weather, mostly coasting vessels, some from the Baltic; even if there were sufficient water, I think it would be doubtful whether they would come in or not. I consider Yarmouth Roads a very safe anchorage at any time, but it is always a hazardous experiment to run into the harbour when there is a heavy sea on the bar, yet it might be done on an emergency. The bank near the north pier is often thrown partly across the entrance; the greatest change I have known in the sand has been from the wind blowing from the north or north-west, when it has been thrown up for 4 or 5 feet perpendicularly. I do not know that the bar has ever been bored to ascertain the depth of sand and shingle; at the north pier, in piling at the depth of 7 or 8 feet, we found clay; I think it possible that by keeping open and thus scouring the channel, we might have a greater depth of water, but the effect on the piles of the pier would be serious; at present the piles of the south pier require to be secured; the river turns at a right angle at the Brush, and to obviate this a portion of the opposite point should be cut off, as proposed by Mr. Walker, and a little of the Brush itself should be filled in; but there is great difficulty to contend with in making any improvement on account of disabled vessels coming in without anchors, which, as they cannot moor, to prevent their damaging other vessels, we are obliged to run on shore; the portion of the Brush already taken in is felt as an inconvenience from its lessening that accommodation; I think there will always be a point opposite the Brush, from the sand and shingle coming into the harbour and depositing there; and this is better than if it were allowed to enter the stream, and settle in the centre. I do not think the ebb scour would carry out what the flood tide would bring in; I think that if the whole of the skeleton work on the north side of the entrance were piled in, it might direct the ebb, and be advantageous, but the beach inside of that skeleton work is very necessary to receive the heavy sea which runs into the harbour; if the pier were planked up smooth, you could not run a ship there on account of the sea. I do not think any different direction should be given to the piers; if turned to the north, the harbour would be more exposed; the lengthening of the northern pier has been beneficial by its throwing the ebb tide more directly over the bar; whatever distance the north pier may be run out, the beach and bar will naturally follow it, and if the trial were made, it should be extended about 50 feet at a time; the shallow water of the bar extends about 200 or 300 feet; there is generally rather deeper water round the south pier than a little further off. The flood tide runs from the south-west close round the south pier, and I think prevents deposit there, but throws the shingle on the north point opposite the Brush; giving a more easy sweep to the outgoing tide would remove this; but I think it should be received there rather than allowed to go up the stream; the south pier is a solid wood pier filled in; the piles are cased with scupper nails, which preserve them from a very destructive worm which would otherwise destroy a 12-inch pile in six years; the scupper nails make them last for 15 to 20 years. The north pier is close below, but open above high water mark; it is only sheet piled on the northern side, and it is that which collects the sand to the northward of it. [Mr. Thos. Crane's project for a dock at the back of the Anchor and Hope being produced.] I do not think that an entrance could be preserved as proposed there; the sea does not drift the sand and shingle into the harbour so much as the tide does, which moves along the coast at about 3 miles an hour. The bottom of the harbour is composed of mud, sand, and shingle; the bar is sand, with a little shingle, and is sometimes hard and sometimes very soft; the anchoring ground in the roads is mostly good, but there are many wrecks on the coast. In the year 1836, 24 or 25 sail were driven on shore in one gale; it arose, in my opinion, from their not getting under "close sail" in time, and from their not being sufficiently anchored; generally speaking, they put off reefing too long, and some owners will not give more than 50 fathoms of chain-cable to their vessels; the wrecks since the last Cockle Gat light was placed may have decreased, but many wrecks occur when a new light is placed; the notices are only given at the Custom-house and in the newspapers; I think it very often the case that the masters do not read the notices; in the case of one wreck that happened, the master had not seen or had not read the notice, and he ran on the wrong side of the light vessel, and lost his ship; masters should be made to sign a receipt for the notice, as when they go to the Costom-house they are generally in a hurry, and indeed as the old notices are allowed to remain, a man may read half a dozen before he knows what they are about.

When dredging, we take up from 500 to 600 tons of shingle in a day's work; we usually begin in the month of April, and work up to October, November, and evan the beginning of December, when the weather will admit. The stuff dredged up below bridge, is landed on the shores on each side, and taken for the improvement of the quay, or for any purpose which may be required afterwards; that taken from Breydon is put on the marshes; it is mud, and we can make no use of it; that taken

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from the haven is fit for ballast when dry. I am not aware that the haven Commissioners could sell it, unless they had a place to put it on; by laying it on the town wastes, as now done, it becomes the property of the corporation. Raising it costs 9*d.* to 10*d.* per cubic yard, including the repairs of engine, &c.; shingle can be raised for 6½*d*, but has cost 9½*d.* per ton.

Mr. MILLER, harbour-master, stated, that 11*d.* a ton was charged by the Corporation for ballast to ships, including the charge for putting it on board.

Captain SMYTH.—If it were put in a proper place to drain, what we get from the bed of the river would do for ballast, but we have not had occasion to employ the engine in the channel for the last four or five years. I think the large shingle in the channel comes past the Brush, and the sea or tide brings in the small, and a great quantity of sand blows over from the Denes into the harbour in heavy gales.

In regard to the navigation above bridge, we are now widening and deepening the channel to the rivers above Breydon, to five feet or five and a half. We have dredged the whole of the south side of the channel below Middle Cross, and have widened it 30 feet; it is now 100 feet in width from the Middle Cross; there are more than eight feet of water in the channel; at high-water the flood tide flows above two feet over Breydon Flats. By taking any part of these flats away, or by deepening the channel, we should increase our back water.

There are about 4,500,000 tons of back water received and discharged from the harbour at each tide; there would be a material increase of this natural power, if the haven were widened at the bridge and at the entrance. In regard to encroachments on the Waveney and other parts of the interior navigations, it is enacted that the committee of survey every three years should inspect them, and notices of encroachments should be given; remembers only one committee of survey in the last 10 years.

The COMMISSIONER read the 29th section of the 5 and 6 Wm. IV., c. 49 (1836), which directs a survey by the Commissioners of the navigation at the least once in every three years, and asked why these surveys had not been made oftener?

Captain SMYTH.—I believe, until the survey in 1843, no survey was made; but the Beccles Commissioners surveyed their river; and the city of Norwich theirs.

Mr TOLVER said that only one survey had been made, as it was thought unnecessary to go to the expense.

Captain SMYTH resumed.—There is a great irregularity in the form of the north pier, and I think it was so constructed many years ago, purposely to check the sea. It is high water in Breydon when it is half ebb at the bridge; there are three hours between the harbour's mouth and the upper part of the Breydon; and about half an hour between the Brush and the bridge, the distance being 2¼ miles. There have been several engineers employed here, but I cannot say we are acting upon any of their suggestions, because we are doing nothing but clearing the channel. Mr. Walker and Mr. Rennie have recommended the channel to be widened at the Brush. We are not acting systematically on any engineer's report. We shall repair the pier, and there is nothing more that I could propose, except cutting off the S.W. corner of the north pier when the south is put in order.

Mr. J E. LACON, treasurer to the haven and pier commission, handed in his accounts, by which it appeared that the income of the commissioners for the last year was 12,300*l.* Previously to that it was about 10,000*l.* He believed that the whole of it has been expended about the harbour.

Captain SMYTH.—During this year we have incurred an expense of 1,580*l.* for timber; the dredging has cost upwards of 14,000*l.* within the last nine years, or about 1,500*l.* a year; and timber for repairing the piers and quays at Yarmouth has cost nearly as much; the only stone quay in the haven is the Trinity wharf, which, I believe, was constructed two or three years ago by the Trinity House. I am not aware of any reason for not having stone piers. The foundation of the Yarmouth timber quays is not deep enough to allow for dredging. The amount laid out upon them is only 200*l.*, or 300*l.* a year. Every person formerly kept their own part of the quay in repair, but since 1836 the whole of the money expended has been laid out under the haven and pier commissioners. As pier-master I attend the meetings of the haven and pier commission, but my opinion is not asked on all occasions. There are two sailors and one shipowner on the commission: they have no resident engineer; and whatever has been done has been at my suggestions, and I think any recommendation that I might make would be attended to. I believe there has been no attempt to increase the accommodation of the shipping in proportion to the dues they pay; some vessels might be laid alongside the Ordnance quay, but it belongs to the Ordnance, and they object to mooring vessels to their posts. The depth of water close to the quays is seven and eight feet; further out there is 10 or 12 feet; there is just enough to enable vessels to ground and remain steady. Vessels careen at the upper part of the harbour; they are hove down, and do not interfere with the shipping. There have been no tide observations of late years at Beccles or St. Olave's bridges; the tide has increased considerably at Norwich of late years; craft, in consequence of the increased flood, get backwards and forwards more easily than they used to do, and I attribute the increased depth and rising of the tide to the clearing of the Breydon, the mouth of the north river, and of the haven below bridge. If these operations were continued, the velocity of the tide would soon be increased. St. Olave's bridge on the Waveney is a great obstruction to the tide; it is built aslant, not directly across the stream, and that position impedes the tide.

Mr. MILLER, harbour-master, stated that there was a strong tide there (at St. Olave's) of four knots; he considered the navigation would be better, and there would be more back-water for the harbour if the bridge were removed.

Mr. FRED. W. FARR, Beccles haven and pier commissioner, stated that there were about eight or 10 feet space under the arch at low water at Beccles bridge, but at high tide the arch was impassable by vessels. In the Beccles river we have a depth of eight or nine feet, but the passage to Yarmouth haven is stopped, because there are only two or three feet water on Burgh Flats, and thus a portion of the back-water and scour for Yarmouth haven is entirely lost. I recollect Burgh Flats 30 years ago; there was more water on some parts of it then than now, but not more in the channel; pleasure boats used to ground there, but they do not do so now, in consequence of the dredging which has taken place under Captain Smyth. It is generally admitted that the removal of Beccles and St. Olave's bridges would be an improvement to the navigation.

Mr. TOLVER, clerk to the haven and pier commission, stated that in floods wherries had passed over

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the road at Gillingham dam instead of passing under the bridge, and pointed out to the Commissioners a wherryman present, called Annison, who had done so. This man further informed the Commissioners that his wherry was about 14 tons, and on one occasion during land floods she was light and could not pass under the bridge, and therefore came over the marshes into the river, about 100 yards below the bridge. He knew many similar instances. He also had been often lying at St. Olave's bridge, where nine times out of ten he could not get through; it is a very dangerous bridge; it frequently happened that wherries strike the bridge and sink there.

Captain Smyth stated that he was quite sure that the improvements that had taken place in the bar and haven had resulted from dredging in the harbour, and removing impediments to the flow of water; that if the water-way were increased where impediments exist, the harbour might be further improved; and at half tide the harbour could be made sufficient to receive craft not drawing more than 11 or 12 feet water, provided they had better accommodation by docks or otherwise when they had entered. He thought that about 2837 vessels came in last year (exclusive of fishing-boats); of these 255 had cargoes, and the remainder (2377) without. If he had power to direct improvements in order to accommodate the trade and commerce, he would deepen the whole haven, lessen the curve, and take a portion of the point off opposite the Brush; put sheet piles to nearly low water mark, and a whole range of skeleton work and guard piles to prevent vessels going on the stakes; make a basin at the lower part on the west side of the haven, on the Gorleston marsh, sufficient to afford accommodation to the shipping. Docks he thought objectionable, as the vessels must be hauled out separately; but he would have piles and dolphins on both sides of the river for vessels to moor to; he would also widen the water-way at the bridge.

Mr. Miller, harbour-master.—With reference to vessels lying close to the bridge, and impeding the flow of the tide, stated that he had not power to remove a vessel from her own yard warehouse: that there was one steamer on the west side, the owners of which hired a cellar in order that she might have the right of stopping there. He referred to a bye law, made by the corporation in 1828, which prohibited vessels lying within 50 yards of the bridge on its north and 30 on its south side, but it made an exception in favour of vessels which, while receiving or discharging cargo from their own warehouses, were permitted to lie there until their cargoes were so received or discharged.

The Commissioner read sec. 66 of the 5 & 6 Wm. IV. c. 19, which directs that the harbour-master of the haven and pier commissioners, or his deputy, shall have full power and authority to direct the berthing, mooring, placing, unmooring, moving or removing of all vessels in the haven above the Brush, and to appoint, and regulate, and determine the position of such vessels, and the manner of their lying in the said haven, and of loading and discharging their cargoes; and pointed out that this Act took away the power from the old corporation and vested it in the harbour-master.

Mr. Miller was aware that vessels near the bridge impeded the tidal flow, but the harbour was not large enough for the trade of the port at times. He was obliged to act contrary to the Act of Parliament; he had no written orders from the commissioners on the subject. Mr. Walker's recommendations, that vessels should not be permitted to lie near the bridge, had not been attended to; he could not remove a vessel from her own yard, otherwise, he had sufficient power.

Captain Smyth stated, that in 1834, the Haven and Pier Commissioners were seven or eight thousand pounds in debt?

Mr Lacon, the treasurer, stated that there was now a balance of 10,519*l.* in hand.

Mr. Tolver said that this money, by the Act 5 and 6 W. IV. s. 35, must be applied to building a bridge, but that the parties who had contracted to do it had become bankrupt. In July, 1835, Mr. Walker sent in a plan for the new bridge to the commissioners, but that was not adopted.

Captain Smyth.—The whole distance across the bridge at present is 146 feet. Mr. Walker's plan was to increase the water-way. He was to have had three arches of 50 feet span each, four piers of five feet each, and side piers five feet more, making 175 feet of extreme breadth, instead of 146 as now existing.

Mr. Tolver believed that the Commissioners were aware that Mr. Walker and Mr. Rennie had both, in their reports to the Haven and Pier Commissioners, recommended the increasing of the water-way at the bridge whenever a new one should be built, but did not remember any intimation about increasing the water-way being given in the advertisement, when it was proposed to erect the new bridge; it was said that Mr. Walker's plan had been prepared in 1835, but as since that time improvements might have been made in bridge-making, it was therefore thought desirable to get an improved bridge, but the advertisement did not allude to the increased water-way.

From the answers to this advertisement a plan by Mr. Birch was selected, and certain parties contracted to build the bridge. They commenced the works in July, 1843, and in the following year became bankrupts, the work was stopped, and the piles and works have remained, until now, in the same state they were left in that year. The piles, &c., by the contract belonged to the assignees of the bankrupts, and not to the commissioners. The commissioners took the opinion of counsel, and were advised to give notice to the assignees of their intention to enter into new contracts: they advertised without success for fresh contracts. Private contracts were then sought for; of these one was more than 32,000*l.*, the other 28,500*l.* The increase probably arose from the price of iron having risen. Up to this time no payment has been made by the Commissioners for the bridge, or expense incurred, except in law proceedings.

Captain Smyth stated that the additional interruption to the water-way occasioned by the pilings for the new bridge had been, and continued injurious in every way in its effects upon the navigation. There are two steam-tugs belonging to the port, which he found sufficient for the shipping of the haven.

Christopher Bell has been a pilot for about 24 years; the harbour has much improved since he first came to it; considers the building of the north pier to have been a great improvement, and that closing it has prevented the sand and shingle from coming through; considers the shallow point opposite the brush to be formed by the manna (sand and shingle) which comes over the upper part of the north pier, which is not closed. Formerly, he has lain for three days in Yarmouth Roads in a vessel drawing 8½ feet water, and could not get in; but during the last year vessels drawing 14 and 15 feet water have come in. There are now eight feet on the bar at low water; 20 years ago, he recollects it used to be dry at low water; in the high tide of last night thinks there were 18 feet on the bar; considers that this improvement is owing to the north pier: the vessels lying so thick at the Brush

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waiting to go out of the harbour are very inconvenient; there are sometimes as many as 50 sail there, and then they are obliged to lie in tiers five or six deep; there was often damage done to them from want of room, by the laden vessels coming in being frequently caught in the eddy formed by the Brush at that part. During the last ten years the harbour has been much improved by dredging, and the accommodation for the pilots and shipping has been greatly increased under the present pier master. In reference to the pilots and tide lights at the pier head, witness stated that there were 60 pilots and six boatmen, and that they were under "a ruler of pilots," who had been originally appointed by the shipowners, but was subsequently licensed, he believed, by the Trinity Board. It was the duty of this officer and his deputies to collect the pilotage and share it equally amongst the pilots. The pilots and boatmen are divided into three watches, one of which goes to sea to bring the vessels in; the other assists them into the harbour, and the third is off duty; they have a boat of 25 tons to go out in bad weather, and row boats for fine weather. They would pilot vessels up from any part of Yarmouth Roads, if they hoisted the jack or a light. A ship-master is allowed to pilot himself in, but in such a case, as he does not pay any money, the pilots will not render him any assistance, neither will they show him a tide-light on the pier. The tide-light was shipped on a staff for vessels that had pilots on board; but for those who had not, or for strangers, there was none hoisted.

Captain Smyth thought that no stranger ought to attempt to enter the harbour at any time without a pilot; did not think that the light could be made a permanent one, as from the uncertainty of the tide, even vessels acquainted with the port would be liable to make mistakes.

The Captains of steam-vessels complained very much that they received no assistance on entering the haven because they took no pilots, and at night no light was shown to them. He had not the control of the light. It had been stated that if he were to hoist one, and any accident were to occur, an action would lie against the Haven and Pier Commission; the whole management of it was therefore left to the pilots. The steamers therefore rarely entered by night, and on one occasion when the "Ailsa Craig" did so, she was very nearly lost. He did not think a permanent tide-light should be put there; vessels would be lost in attempting to enter, as they often required assistance by warping when they got to the pier.

Christopher Bell—Was a gat pilot. There were about 20 gat pilots at Yarmouth.

William Loune—Has been a pilot for 35 years. When first he became a pilot (1810), the bar and the mouth of the harbour were in a very bad state. The north pier was gone, and he had frequently walked over the bar at low water. It was then of a semicircular shape, with two bad channels on the north and south side of it. The flood then used to set in from the northward, and there was no north bank. Building up, closing, and extending the north pier had benefited the harbour by forming a north bank, and throwing the flood-tide off, so that it now came in from the southward instead of from the northward. They now had eight feet at low water, and could get vessels in at high water drawing 12 to 15 feet. A N.N.W. wind was a very unfavourable one for entering the harbour, and with it they could not keep vessels clear of the piers. He was of opinion that so long as a good north pier should be maintained, there would be a good bar; and he generally confirmed what the preceding witnesses had said with respect to the want of accommodation for the shipping, and the inconvenience it occasioned—to remedy which he suggested the formation of a basin in the Gorleston marshes. He did not think any place could be substituted for the Brush, for the accommodation of vessels waiting to go to sea when the wind was from the northward.

Charles Runnell—Had been a pilot for 14 years. Thought that there would be no difficulty in stowing the vessels away in a dock instead of their lying at the Brush. The outward bound vessels at Yarmouth were colliers who went to sea with a W.S.W. wind, which would be a sailing wind out. He had experienced that vessels so lying there caused great danger, to those coming in, as they allowed no room for them to stay. The harbour was navigable at all times. The ebb was sometimes several knots stronger than the flood. Thought that the vessels would be much less exposed in dock than they were at present; but did not know whether they would like to pay for that convenience.

Mr. William Temple, harbour and ship-master for 30 years. Had seen frequently 800 to 1000 vessels in the Roads. Thought that if there were a dock at the lower part of the harbour, a great number of them would then take refuge in it; he thought the commerce of the port would greatly increase; and he had heard it observed at Sunderland and Newcastle that if more accommodation were provided, the shipping would often take refuge there in south-westerly winds.

Mr. George Parrett, ship-master, testified generally to the want of accommodation, and the injury which vessels sustained from their not having sufficient room. Thought that the Brush ought to be kept clear; and it was the general opinion that docks would be of great service.

Mr. William Thorpe, ship master, confirmed the statements of the preceding ship-masters respecting the want of accommodation and the inconvenience of the Brush.

Mr. Parrett stated that the town jetty used to be a great convenience to the shipping, but that it should be extended further out, as lately the beach had gained so much at that part of the beach as to render it nearly dry at its head at low water. He thought that the masters of vessels in the Roads would not object to pay a shilling or eighteen-pence for its extension, in order that they might get off their supplies and water when wanted.

Captain Stanley, of H.M.S. "Blazer," Commander Wood, and Lieutenants Smyth, Roberts, and Digby, of the Coast Guard, all testified to the inconvenience of boats landing at the jetty in its present state in bad weather or at low water, and therefore recommended its extension, or that some more permanent structure should be erected, which, they stated, would be equally a benefit to the Royal Navy, the mercantile marine, and to the town itself.

Captain Jerningham, of the Coast Guard, corroborated the statement of the preceding officers, and said that at times so great was the difficulty of boats landing, that vessels had been obliged to go on to Harwich for provisions, from their not being able to ship them at Yarmouth.

Mr. Thomas Candler had resided five years in South Town. During that time there had been several extraordinary high-tides. There was one on the 26th of January last. Last night there was a high tide, and on the high road there were in many places two feet of water, and in my own garden there was one foot. It even flowed into the houses.

Chairman.—Where did it make its escape?—I think it made its escape into one of the ship yards.

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To what do you attribute the flood?—I think much of it must be attributed to the interruption presented by the numerous piles which are at the bridge. We used to have the floods on the quay at the premises near the bridge, but now we have them sooner at the warehouses below than above the bridge.

Mr. **Wm. Barford**.—The difference of the level of the water was eight inches from the north to the south side of the bridge on 26th January. Last night it was not four inches. The tide was not so high last night by 11 inches, and the shoot of water was only about 11 inches. A high tide frequently raises the water at the bridge when there have been strong gales in the north sea, and when the wind is W. or W.N.W.

I believe it is possible to increase the water-way at the bridge so as to prevent that rise of tide. I observed the flow of water in South Town. It was from the defects of the slips on the west side. Lately they have been raised. The slopes being thrown more perpendicularly on the east side, the tide flows more on the west.

Mr. **Candler**.—We were obliged to put earth embankments up to stop the tide last night. It was very near over them. We never had a tide that did the injury that has been done by those tides which have occurred since the piling has been driven for the erection of the new bridge. More than 20 years back there was a very high tide, but from that time to last year none have occurred.

Have you complained to the Haven and Pier Commissioners of the injury?—I have not, but many of my neighbours have suffered very much indeed. I think there is not height enough at the slips on the west side but the bridge has something to do with it.

Captain **Smyth**, R.N.—What observations have been made with respect to the height of the tide? A register has been kept at the bar, and also below bridge, according to Mr. Walker's order, which observations I am able to refer to. In 1826, there appears to have been a difference of level between the pier and the bridge of 11½ inches. That is the mean of the observations. In 1837 it is reduced to 11 inches; in 1838, the mean is reduced to 7 inches. That continues with very little variation till 1844. In 1845, it gives a result of 11½ inches, going back to 1837.

How do you account for that?—The only way in which I can account for it is in the obstruction at the bridge. I account for the lowering of that difference from the old bridge being removed, the piles being drawn, and the present bridge being substituted. There was more space for the water to pass, and consequently for scouring and deepening the channel of the river. In consequence of the increased impediment thrown in the way by the new piling, the difference appears to have come back to what it was in 1826. I was not aware of that till now. These facts are from observations made without being aware of their relation to each other. I have no hesitation after finding these results in stating as my opinion, that the difference of the level depends on the difficulty of the passage, and anything removing that obstruction would lessen the difference. I consider the current at the bridge particularly strong.

Frederick William Farr, Esq., Mayor of Beccles.—I am one of the committee, and a member of the Board. I have the superintendence and payment of the money of the haven and pier, granted to the Beccles river, and I have to sign all the accounts.

I receive from the Haven and Pier Commissioners about 200*l*. per annum, which has been expended almost entirely in the dredging of the river Waveney, and there are some two or three wharfs that have to be kept up. The whole distance of my superintendence is 21 miles. It extends from St. Olave's bridge to Shipmeadow lock, four miles beyond Beccles. The channel is from shore to shore of the river. It is a capital river; one of the best, the depth being about 11 or 12 feet. From the lock I named, it becomes a private navigation, and there my jurisdiction ends.

Does the tide rise on that lock?—Except on extraordinary occasions not more than six inches. At St. Olave's bridge and Beccles bridge, new bridges, with increased water-way, would give at flood tide more water, and at ebb tide you would draw the water from the Bungay navigation. That would increase the depth of water. When we have floods the boats lie there a fortnight or three weeks, being unable to pass the bridge. We dredge by hand, by men, with a windlass, using a small craft carrying about 17 or 18 tons. We cannot raise above one load a day, about 109 tons a week, at an expense of 4½*d*. a ton, exclusive of the first cost of the lighter.

What do you do with it?—We deposit it on the side of the river, upon the banks.

Would it not be a great advantage to the town of Beccles, if the navigation by the Waveney were improved?—It would. We want to have the water deepened above. We have plenty of water up to St. Olave's bridge. We have no part of the river with less than nine feet below that. The bridge prevents the floods going up and the back water returning, so that the back water is stowed up for miles and miles. If we had a wider bridge, the water would get away quicker, and begin to go away sooner. The water runs into the river out of ditches, and brings down a considerable deposit of soil that comes with it from the country. It would always be necessary to dredge, though the bridges were removed, because there would be always a deposit from the land soil. The state of the bridge has been presented at the sessions of the county of Suffolk, by myself at the quarter sessions, in September last. If these impediments to the navigation up and down were removed, the navigation would be much benefited, and the malting premises would be greatly improved.

Mr. **Patrick Stead**, merchant, of Halesworth and Beccles, stated.—The bridges at Beccles and St. Olave's are great nuisances; the water-ways are small, with confined heavy built piers, and very low arches, particularly at Beccles; whenever a frost breaks up with rain, the whole level of many thousand acres of marshes are flooded, and the water runs over Beccles dam and turnpike road several feet deep; passengers have then to be conveyed by boats over the turnpike-road. I will give you an instance of mischief we have suffered from the nuisance created by Beccles bridge, causing the sudden flooding of all the property adjoining the river at Beccles. I stopt one evening at my clerk's house, at Beccles bridge, when I anticipated a flood, I left the sitting-room quite free from water at 11 P. M., and at 4 o'clock next morning, I was called and obliged to be assisted out by one of the watermen, in consequence of the lower floor being flooded knee-deep;—we were compelled to remove all the malt in process on the lower floors of my malt-houses, which was very much damaged and some entirely destroyed and washed away by the flood. The ice not being able to find its way through the smallness of the arches of Beccles bridge, blocked up the water-ways, and had to be cleared away by means of half hundred weights, slung by ropes, let down over the parapet of the bridge to break the sheets of ice. Floods of this nature occur every year; lately they have occurred four or five times in one season.

Appendix B.

Great Yarmouth.

No. 240.

Evidence taken on the 21st Oct., 1845.

I consider the removal of these bridges would prevent such calamities, and improve the navigation of the river and the drainage of the lands; Capt. Hamilton Fulton, who surveyed the river by order of Mr. Rennie, in 1819, said the Beccles bridge was one of the greatest nuisances in the river, and very injurious to its navigation of the river and to the Yarmouth harbour.

Mr. Brighton Silver had been tide surveyor to the Customs for about 32 years; his station was at the mouth of the harbour; about 3000 vessels a year visited this port; he had no means of ascertaining how many of these had come to take refuge; the old jetty, 100 yards to the northward of the north pier, should be maintained as it prevents the beach and sea from setting too hard against the north pier, for which purpose he thought it would be beneficial if the old jetty were extended 400 or 500 yards further out. This witness agreed with the pilots in regard to the benefits which had been derived from the north pier, and it was also his opinion that the north pier should be entirely closed, to prevent the sand and shingle coming through and settling on the point opposite the Brush.

Mr. Benjamin Dowson, merchant, South Town, agreed with the preceding witnesses, in regard to the improvements that had been made in the harbour; in his view, as much good would he done by shortening the south pier, as by lengthening the north; an entrance might be cut through the south pier, and a channel made inside the upper station-house; this would obviate the necessity for cutting off the Brush; considered the north pier was the cause of hundreds of acres of land being lost, and that the further out it was extended the more of Corton Cliff would be washed away. He thought that if a basin were constructed, it should be on the west side of the harbour, as then vessels could run into it under sail; he considered that the want of water-way at the Yarmouth Bridge injured all the navigation above it; he thought the bridge ought to have from 12 to 24 feet more water-way at least; he thought the Burgh Flats were accumulating, and to prevent the injury which the drainage would sustain, they should not be allowed to get shallower. He complained that a great portion of the scouring power at present was uncertain, from its being dependent on the freshes and drainage, for about three months during the winter, and that during the remainder of the year the scouring power was very deficient.

Mr. Thomas Crane explained his project for making a harbour in the South Ham, just to the southward of the present entrance.

The Chairman adjourned the inquiry.

No. 241.

Great Yarmouth adjourned Inquiry at the Town hall.

No. 241.

Evidence taken on the 6th Nov., 1845.

Examining Commissioner—Joseph Hume, Esq., M.P.

Present—H. N. Burroughes, Esq., M.P.; S. S. Beare, Esq., of Norwich, Haven and Pier Commissioners; the Mayor of Yarmouth, John Lacon, Esq.; Capt. Manby; R. Ferrier, Esq.; R. Cocks, Esq; R. Bullard, Esq.; Isaac Preston, Esq., Recorder of Norwich; and many other individuals, of all classes.

Several of the oldest pilots, amongst whom were John Legget, John H. King, Thomas Newson, James Wood, and Joseph Salmon, informed the Commissioner that the Gorleston marshes, before they were enclosed, were covered at high spring tides.

Mr. Crane, sen., stated, that before the enclosure was made in 1813, he had rowed close up to the cliff, and the other witnesses generally confirmed his statement.

Mr. Tolver, town clerk, stated that at the time the enclosure was made, he was in the town clerk's office, and that no opposition had been made to the enclosure on the part of the corporation, who were then conservators of the river. Part of this enclosure was at present the property of the corporation. There was not a clear right of way along the east side of the harbour; it was interrupted by Mr. Palmer's fish house and several private docks. This part had been allotted by grants under the corporation many years ago: these were originally leasehold grants; but within the last 6 or 7 years they had, with the sanction of the Lords of the Treasury, become freehold property. Clause 35 of the Haven and Pier Act recognized the property of Mr. Palmer; but at the same time a right of way, 10 feet wide, along the river banks was provided on both banks of the river.

Mr. Lamb, aged 85, recollected that when he was a little boy there was a clear right of way along the banks of the haven from the haven's mouth to the entrance of the river Bure and to the Breydon.

Mr. John Costerton stated, that when he was harbour-master, he never allowed vessels to remain near the bridge; and he considered that the Haven and Pier Act gave the power to the harbour-master to berth the vessels as his own discretion.

Captain Smith exhibited a plan of the Breydon, and pointed out two transverse sections which be had recently made on the same lines that Mr. Walker had taken in 1826. The difference in the mean depth, as shown by these sections, was 18 inches in the upper part and 17 inches in the lower, less water than there formerly was in 1826. He had no doubt that one cause of the Breydon silting up was, the narrowness of the haven at the bridge, and at a part a little beyond the brush, and that the point opposite the brush could not be improved while the shape of the brush remained as it does—if the curve of the brush was altered, accommodation must be provided for the shipping.

Mr. Richd. Ferrier, Mr. C. Corry, and Mr. Geo. Neslin, spoke to the general silting up of the Breydon.

Commissioner.—As a resident in Yarmouth, do you not think the appointment of a Commissioner by the Government would be an advantage? Mr. Lacon, Treasurer.—I think it would be most desirable to have some general adviser, as an engineer. As far as the management of the funds go, I think not.

You think that the money which is in the hands of the Commissioners should be expended under the direction of an engineer?—I think it would be very desirable.

Do you, as treasurer, keep copies of the detailed expenditure by the Commissioners at Beccles and Norwich?—Not of the money advanced to them by the haven and pier Commissioners. I have only to pay them the amount of their bills every year.

Then the books of expenditure of the moneys advanced by the Haven and Pier Commission to the Commissioners of the Bure river are not lodged with you?—No, but I am also treasurer to the Bure Commissioners.

How many Commissioners are required to sign a cheque?—Only one. And if any one of the three Norfolk Commissioners sign a cheque, I pay it.

Have you any account of the bills of expenditure from Motley dyke?—I have not the bill.

Is there any audit of your accounts?—Yes; every half-year, by the Commissioners, Mr. G. D. Palmer, Mr. Hammond, and Mr. Barker. Previous to each half-yearly meeting, I furnish each of the Commissioners with a copy of the account.

Appendix B.

Great Yarmouth.

No. 241.
Evidence taken on the 6th Nov., 1845.

Then heads are drawn by you from the cheques they give?—Yes, they are supplied under two different heads.

Commissioner to Mr. Tolver.—Do you keep the accounts of different branches?—No.

Do you keep in your office any accounts of the expenditure?—No.

Supposing I, as a rate-payer, wish to see how the money is expended?—The 93rd section of the 5 and 6 Will. IV. c. 49, applies to the different branches, and requires an account of each navigation to be separately rendered.

By whom are those accounts held?—Those of the North River are made out and delivered to the justices of Norfolk.

Where can a rate-payer have access to those accounts?—Mr. Lacon: He might hear from me what had been paid out and what received, but not the detailed expenditure.

[*Referring to Copy of Treasurer's Account produced.*]

Do those gentlemen who receive the money leave their books with you?—No.

You have no copy of their accounts?—Mr. H. N. Burroughes, M.P., Haven and Pier Commissioner, stated that an account or estimate of the work to be done is sent in by Mr. Wright, and when the bill for the work is sent in, it is compared with the estimate, and if his account corresponds with the estimate, it is passed.

And the Commissioners check that account of the work done by a different person?—Yes.

Do you belong to the Bure Commissioners?—Yes; there are Commissioners appointed, but they are all amalgamated. They, however, give a separate account.

When you sign the book, what proof have you that the work charged in those bills has been done?—There ought to be a survey, and we ought, according to the Act of Parliament, to go through those rivers once in three years. I believe that has not been done. I have not been able to attend to it myself.

Are you aware that a survey has been made only once in 10 years?—It has been objected to, on account of the expense, by the County Commissioners.

How do you know that Mr. Wright has not had mud taken up out of one place and deposited in another?—I must trust to the honesty of the person as I would if I employed him privately.

If you direct on your own estate a dyke to be drawn, whatever the expense may be, do you pay the man for doing it without some person seeing that the work was done?—I might do so, though I think it would not be right.

What is Mr. Wright?—He is a boat-builder by trade.

Commissioner.—I should wish to ask Mr. Burroughes, as one who has acted as a Commissioner many years, what, in his view, would be the benefit or inconvenience of having a Commissioner appointed by the Government acting with the local Commissioners?—I think it is desirable that there should be a Commissioner entirely unconnected with Norwich or Yarmouth.

Then is it your opinion, resulting from experience, that a certain portion of the Commissioners being appointed to protect the public interest would be beneficial?—Yes, I am sure it would.

What is your opinion of the propriety of expending the money under professional advice?—I am so strongly of that opinion that I refused to take the responsibility on myself of that of which I can have no knowledge whatever.

You know Mr. Walker was consulting engineer, when was it that the Commissioners, as a Board, last consulted Mr. Walker as to the improvements of the harbour?—I can hardly say. Mr. Walker was the consulting engineer to the Commissioners, but not a salaried agent. He came down to inspect the suspension bridge, and I saw by the reports in the papers that he there stated himself to be the consulting engineer. I then put the question to Mr. Tolver if Mr. Walker was consulting engineer, and at the next meeting of the Commissioners I made a motion on the subject.

Mr. Tolver then read the following extract from the minutes of a meeting held 1st July, 1845: "Mr. Burroughes moved that the Commissioners do appoint a consulting engineer, which was seconded by Mr. Stracey, whereupon Mr. Springfield moved, 'That the Commissioners having investigated the plans and specifications of Mr. Birch for a new bridge, see no reason to withdraw their confidence,' which was seconded by Mr. Farr, whereupon there appeared five votes for the amendment, and on putting the original motion there were five votes in favour thereof," and the chairman having a casting vote, the amendment was carried.

I understand you to say that it is your decided opinion, having moved in the commission for that purpose, that the funds of the haven and pier should be expended under an engineer?—Yes.

Is the haven and pier court an open court or private?—Private.

Does the Act direct it to be private?—No; it is quite silent: and I have moved several times that reporters be admitted. I am very desirous, and am strongly of opinion that this court should be an open court; or, at all events, that reporters should be admitted. The court might retire to consider any special points.

Generally you consider that the proceedings of a Board for carrying out the objects of an Act of Parliament should be an open court?—I go with you generally, but I confine myself to this commission.

I mean this commission?—Most decidedly. It was moved at the last committee.

Do the proceedings show your own opinion of that? What is the date of that motion?—The 20th October. Mr. Tolver read from the minutes: "Mr. Burroughes moved that reporters be admitted, which was seconded by Mr. Beare."

(Mr. Burroughas, to the Town Clerk, read the minute with regard to the publications of the proceedings.) Mr. Tolver read from the minutes of the meeting of 15th July, 1845: "Mr. Burroughes moved that the entire proceedings of the 29th April, 1st July, and of this day, relating to the bridge, be published in the two Norwich papers, which was seconded by Mr. Leathes. Mr. Beare moved as an amendment that the proceedings be inserted as a paragraph, but be not paid for as advertisements, which was seconded by Mr. Palmer. The amendment was put, when there appeared seven votes, and it was carried.

Are any of the accounts printed?—No; with the exception of those under the Norwich corporation, which are printed annually and distributed.

To Mr. Mills, of the firm of Mealing and Mills, malsters, Norwich.—Do you send malt to London?—Yes.

What is the expense on it?—The total expense of delivering it to the brewery is 25*s.* 9*d.* a last.

Have you the items?—Yes. [*They were handed in.*] That includes every charge to the brewery.

If you were not to tranship, but to ship it directly from Norwich, what would the difference of charge be?—The charges I have stated are for sea-borne vessels. We ship all our London malt by sea-borne vessels.

What is the expense of transhipment, if you send it by Yarmouth to go to London?—I think somewhere about 3*s.* 6*d.* to 4*s.* a last more.

That would be 29*s.* 3*d.*?—Yes. There is the river freight and working here. Independent of that, there is always breakage from working of the wherries, besides the delay.

Have you any knowledge of what will be the effect of the railways that are now being established from Norwich on carriage of goods?—It will decidedly interfere with the present mode of transit.

Have you any data on the subject?—There will be a great saving. Supposing the railway undertake to convey malt from Norwich to London at 1*s.* 4*d.* a quarter, and for a large quantity perhaps 1*s.* 1*d.*, that will make a saving of 1*s.* 1*d.* a quarter.

APPENDIX B.

GREAT YARMOUTH.

No. 241.

Evidence taken on the 6th Nov., 1843.

What reason have you to believe that the Railway Company will do that?—They have offered to do it for 1*s*. 4*d* for small quantities, and 1*s*. 1*d*. for large.

What difference will that make in a cargo of 100 tons?—A vessel of 100 tons would take 600 quarters of malt, which would make a saving of about 32*l*. 10*s*. I have not included carting from the malting-house to the railroad, which would be about 1*s* 8*d*. a last additional. It wouldreduce the saving to about 27*l*. 10*s*.

Do I understand you, that unless the expenses of shipping from Yarmouth to London be reduced, there will be danger of the malting trade being carried by land instead of by water?—I do not think we should ship malt here.

Have you received any orders from those who purchase malt in London to avail yourself of the railway?—Yes.

Is not the brewery in London that you ship malt to, near the Shoreditch station?—Very near. They have purchased the property adjoining, and intend to lay down a private tram-way to run to the station.

Will the same facility be afforded to Meux & Co., who live at a distance?—No; they will have to cart it from the terminus.

Will that expense be more than the difference of the expense by railway?—No; decidedly not.

Are you of opinion that the brewers in London will avail themselves of the railway?—Yes.

What is the amount of the exports of malt from Yarmouth in one year?—Mr. STEAD, merchant and malster of Halesworth, Beccles, and Norwich, said that 78,000 quarters is the quantity of grain shipped at Yarmouth, which is the largest exporting port in the world perhaps, excepting only Taganrog and the Shannon, may thus be stated:—

Malt	80,000 qrs.
Barley	160,000
All other kinds	160,000
Annually . .	400,000

Mr. MILLS.—Is it probable that any part of this malt will find its way to London by merchant vessels when there is a railway between this place and the metropolis?—I think not.

Then in your view it is of the utmost possible importance to preserve the trade of the port that they should reduce the harbour dues on shipping as much as possible?—Yes.

You know the brewers that live in different parts of London, Barclay's, on the south side of the Thames. Did you, in speaking of the whole 80,000 quarters of malt, suppose that Barclay's would avail themselves of the rail? No doubt of it, provided they get it up cheaper, and there is no doubt they will. They will all go on the rail.

Mr. STEAD.—I have inquired into the general charges made by railroads in England, Ireland, and Scotland, and I understand that corn is carried at 1*d*. per ton. per mile. In Northumberland and Durham, coals are carried at *d*. per ton, per mile. The present charges incidental upon the conveyance of a last of malt of 10 quarters to London, are as follows, from—

	Woodbridge.			Halesworth.			Norwich.		
Viz.—	£.	*s*.	*d*.	£.	*s*.	*d*.	£.	*s*.	*d*.
Lighterage		..		0	2	0		..	
River dues		..		0	0	10		..	
Loading		..		0	0	8		..	
Freight	0	11	3	0	11	4	0	13	8
Dues		..		0	1	8		..	
Captains' farthings and entry . . .	0	0	2½	0	0	2½	0	0	2½
Metage	0	3	8½	0	3	8½	0	3	8½
Wharfage	0	0	10	0	0	10	0	0	10
Insurance	0	2	11	0	2	11	0	2	11
Packing	0	0	8	0	0	8	0	0	8
Cartage and sacks	0	5	0	0	5	0	0	5	0
Charges by sea per last of 10 quarters .	1	4	7	1	9	10	1	6	10
Charges by rail per ditto, and cartage and use of sacks 5*s*. per last . . .	0	12	11	0	15	0	0	15	10
Difference in favour of the railway per last of 10 quarters	0	11	2	0	14	10	0	11	0

independent of which there is a partial sea damage not payable by underwriters. The breakage of the malt, on two or three times transhipment, we find is 2 per cent., or 12*s*. per last, which by rail-road may be reckoned not 1 per cent., or 6*s*. per last; those are most material drawbacks to sea carriage.

Do you mean to say that the injury sustained by transhipping and by breakage, in filling and emptying, amounts to 6*s*. per last?

I mean that 30*l*., being the value of a last of malt, 1 per cent. for decrease is 6*s*. which is caused by the treading of the porters, matters, &c., in the repeated measuring and re-measuring of the malt into boats, ships, and carters' sacks; as malt is shipped in bulk to London, this decrease amounts to, by sea, 2 per cent., whilst one measuring by railway will not be 1 per cent; hence the total saving in the freight and breakage, in sending by rail, will be 17*s*. per last. The railways reckon 8 quarters of malt and oats, 6 quarters of barley, 5 quarters of wheat, beans, and peas to the ton weight.

What dues do you pay at Halesworth?—I have shipped above 20,000 quarters of malt this season.

	£.	*s*.	*d*.
The river dues upon which I paid one penny per quarter	83	6	8
Harbour dues at Southwold two-pence per quarter	166	13	4
I paid dues upon malt	£250	0	0
I have imported this season 3,000 to 4,000 tons of coals and cinders, say only upon 3,000 tons:—			
River dues 9*d*. per ton	112	10	0
Harbour dues 1*s*. 2*d*.	175	0	0
	£287	10	0
I therefore have paid for river dues	195	16	8
Ditto, harbour dues	341	13	4
I paid last year	£537	10	0

Independent of dues upon wheat, barley, &c., the entire dues of Southwold harbour are 1,000*l*. per annum, and of the river Blyth 400*l*.

APPENDIX B.

GREAT YARMOUTH.

No. 241.
Evidence taken on the 6th Nov., 1845.

Is it your opinion that the dues paid at Southwold harbour will be lost?—Yes, I believe that all our malt will go to London by rail, and that all the coals for that district will come through Yarmouth instead of Southwold, Aldborough, Snape, and perhaps Woodbridge; and a great proportion of the corn grown within 10 or 15 miles of the proposed coast railroad from Yarmouth, Beccles, Halesworth, Yoxford, Saxmundham, Framlingham, Wickam Market, Woodbridge, Ipswich, will be carried to London upon that road. I am able to show that railways will have a great effect upon the coasting trade of the United Kingdom. Amongst the various informations I have obtained, I may mention flour from Belfast to Edinburgh is now conveyed 150 miles in one day at 1*s.* 1*d.* per sack of 280lbs. or 8*s.* 8*d.* per ton; by steam boats from Belfast to Ardrossan 70 miles, thence per rail to Edinburgh 80 miles. Messrs. Grindley, Cowan, & Co., of Leith, the largest cornfactors in Scotland, informed me two months ago that instead of their sending all their grain by ships to Glasgow as formerly, that the Edinburgh and Glasgow Railway Company carried it for 1*s.* 1*d.* per quarter of wheat, for which the Company sent carts to Grindley's granaries at Leith, and transmitted the grain by railway and delivered it by carts in Glasgow to granaries there, including the use of sacks and all charges at 1*s.* 1*d.* per quarter. The mere railway charge for grain between Edinburgh and Glasgow, 46 miles, is 2*s.* 2*d.* per ton, or little more than ½*d.* per ton per mile.

How do you reckon that coals will be imported at Yarmouth instead of Southwold, Aldborough, and Snape, to supply that district of country?—Because larger and cheaper ships navigate to Yarmouth at 1*s.* or 2*s.* per ton less freight; the dues at Yarmouth are 7*d.*, at Southwold 1*s.* 2*d.*, and river dues to Halesworth 9*d.* per ton. I reckon that the difference in favour of importing coals to Halesworth through Yarmouth by rail will be 2*s.* 4*d.* to 3*s.* 4*d.* per ton, or 12½ to 20 per cent. upon the price.

The result of your observations is, that if the rates of expenses by sea carriage be not reduced, the railways will interfere with the coasting trade generally to a far greater extent than is contemplated?—To a much greater extent than almost any person does anticipate. For instance, barley being of a perishable nature, and as considerable quantities are shipped at Yarmouth to the following places, I calculate it would be carried *viâ* rail to the following places, and at the following respective costs:—

	Miles.	Per Ton.		Per Qr.	
		s.	*d.*	*s.*	*d.*
Maidstone	140	10	8	2	0
Brighton	160	13	4	2	2
Southampton	188	15	8	2	7
Birmingham	216	18	0	3	0
Bristol	228	19	0	3	2
Burton-on-Trent	230	19	2	3	2
And even to Liverpool	320	26	8	4	5

The present distance by rail to London *viâ* Brandon, which is 146 miles, will be reduced by the Waveney Valley to 134 miles; and by the coast line, following the present mail and turnpike route, to about 120 miles.

What was the object of your application to Beccles Quarter Sessions, in January 1831, with regard to getting the Beccles navigation improved?—I was much interested in the trade of Beccles then. I knew that a sum of 1,748*l.* lay without interest in the hands of the Commissioners of the River Waveney, collected under the Yarmouth Haven and Pier Act, for improving the River Waveney; and that the justices at those sessions had the ordering of its application. I asked them to apply it as Mr. Cubitt reported, that by an outlay of 1,900*l.* the Waveney could be deepened for sea-borne ships drawing 10 feet water up to Beccles bridge. Mr. Gardan presented my memorial, but the magistrates required a counsel to discuss it. The Beccles corporation soon went to Parliament and obtained a Bill to make Beccles a port, to deepen the Waveney, to make a cut from the river Waveney into Oulton-broad, so as to shorten the navigation by Lowestoft, and also to levy dues therefore. In April, 1831, I sent one of my vessels, the "Friends" from Yarmouth through St. Olave's bridge, and loaded her with the first and only sea-borne cargo at my malt houses at Beccles bridge, 15th April, 1831, for London, where it was soon after delivered. Upon the 22nd April, Beccles Port Bill was passed, and tolls have been collected under it, from 1833 up to this time (1845), upon all sea-borne ships trading at Beccles, amounting to 2,574*l.* 9*s.* 7*d.*: not one penny of that money has been expended in deepening the Waveney, and the cut has not been made: 1,200*l.* of that sum has been paid to the corporation for the expense of obtaining that Act, together with 417*l.* of interest: the collector has been paid 10 per cent., 267*l.*; the clerk has been paid 114*l.*; about 500*l.* stock and balance now remains in hand to pay a second bill, and never a penny has been laid out upon the river.

Do I understand you to say that the balance of money from 1819 to 1830, collected under the old Haven and Pier Act, amounted to 1573*l.*?—That is correct. In 1831, when I applied, it amounted to 1730*l.* This sum, and all the monies collected under the Yarmouth Haven Act, have been laid out in deepening the Waveney from Oulton Dyke upwards to and beyond Beccles Bridge, as recommended by Mr. Cubitt's Report of 1807, but not a penny of the Beccles Port, dues amounting to 2574*l.* 9*s.* 7*d.*, which has been expended in paying for the Act, interest, collector, clerk, &c., as already stated, has been applied to improve the navigation!

Then that Bill was never made available to improve the Waveney?—Never a penny has been laid out about it. There is 500*l.* now in hand, and they have not paid their second bill; they will explain what has been done with that 500*l.* This case shows the necessity of a central General Board being appointed to regulate such matters.

Mr. SHARPIN, clerk to the Beccles Haven and Pier Commissioners.—The 1500*l.* has been expended to deepen the river upwards to nine feet from two miles down below Beccles Bridge. It was in the hands of the treasurer at the time; and by order of the Haven and Pier Commissioners at Yarmouth, it was handed to the Beccles Commissioner, who laid it out for that purpose!

It appears that 2574*l.* 9*s.* 7*d.* has been received by the clerk of the Beccles navigation since the passing of the Act for dues and interest on moneys invested in the funds by them; and the question which I wish to ask is, whether the whole of that sum has not been paid (with the exception of 443*l.* invested in the 3 per cents.) in expenses in seeking the Bill?—Nearly 1,200*l.* has been expended in getting the Bill.

There are two accounts: 1500*l.*, the old balance, has been expanded in deepening the river. Since July, 1834, 2574*l.* has been received as harbour dues; there is a charge of 9*l.* 0*s.* 6*d.* paid to Mr. Cubitt in July, 1834, and also to Newton, 5*l.* 5*s.*; Thomson, for his time at Staith; and Warren, for repairing drill instruments, 16*l.* 7*s.*; these appear to be the whole payments for the improvement of the navigation; is that correct?—No doubt about it.

Then am I to understand that the navigation, which was to be improved by the dues levied under the 1st of Will. IV., cap. 50, has not had any money expended on it to extend the accommodation for sea-borne vessels. Has any application been made for a new Bill?—Yes, a year or two ago.

What was the object of that Act?—To enable the Commissioners to reduce the tolls, because by the original Act the tolls were fixed: there was no sliding scale.

What was the expense of that Act?—300*l.*

How was that paid?—By private subscription.

And notwithstanding that private subscription, no part of the dues has been applicable to deepening the river?—No.

MR. S. S. BEARE, Haven and Pier Commissioner for Norwich, stated that the Norwich Commissioners had no map of their navigation; that they had had one some time ago, but it had been lost.

CAPTAIN MANBY, F.R.S., having laid his plans for making Yarmouth a harbour of refuge before the Commissioners, the inquiry was concluded.

APPENDIX B.

GREAT YARMOUTH.

No. 242.
Extracts from Manship's MS. History of Yarmouth.

No. 242.

Extracts from Manship's Manuscript History of Yarmouth.

Back waters changed their course, and Grubbea Haven, to the north of Yarmouth, stopped up.

The south waters went under the cliff past Gorleston, Gunton, and Corton, and few ships of burthen could safely enter.

14 Edw. III. to 20 Edw. III., anno 1346.

Town petitioned, in his 20th year, to cut a haven by Corton, which haven was made and continued till his 46th year, when it stopped up and no ships could enter, but were forced to discharge in Kirtley Roads, or near the mouth of the haven.

46 Edw. III.

Haven cut three miles more to the north, and 12*d.* laid upon every last of herrings for five years.

16 Rich. III., anno 1392.

Another haven cut, and 1000*l.* granted by the king.

10 Hen. IV., 1408.

2000 marks granted to the town, with remission of 50 marks fee-farm rent for 40 years.

10 Edw. IV.

Remitted the fee-farm rent for five years.

17 Hen. VII.

Another haven cut nearer the town, and a benevolence of 50 marks for 25 years.

23 Hen. VII.

A fifth time suitors of the crown, and another haven cut near where it now is, and 50 marks remitted for 30 years, and all the $\frac{1}{10}$ths and $\frac{1}{15}$ths which should be granted to him. This done, under the advice of the Master of Nottingham College, and cost 1500*l.*

20 Hen. VIII., anno 1528.

Ann. 1548, 2nd Jan.

Ornaments sold out of St. Nicholas Church for the repair of the haven:—

	£.	*s.*	*d.*
Plate, &c.	977	6	6
Houses, rents, &c., belonging to the charnel	192	11	5
Assembly	109	1	8
Commissioners, south and middle wards	33	18	4
Ditto, north and north middle	31	8	0
City of Norwich	133	16	0
Dean and chapter	20	0	0
Strangers, and goods in the hospital	206	6	0
	£1,704	7	11

Anno. 1548. Edw. VI.

With the money received, another haven cut out very near the south gates, and all $\frac{1}{10}$ths and $\frac{1}{15}$ths released, as in former reigns. The king also gave a commission to take up carts, carriages, and labourers, by patent granted the second of his reign.

Mr. Tompson, of Dover, directed the works, begun 16 Jan., 1548. 100 persons a-day employed, but were dispersed by Kett and his army.

Next year the work was resumed, but, for want of funds, was abandoned.

7 Edw. VI., anno 1553.

A Mr. M'Candish was sent to survey the work, and on 8th November, a quantity of shovels, baskets, &c. were sent for from London.

Anno 1556.

Every alderman found two men, every counsellor one man, till the haven was finished; or else to pay 10*d.* a-day for a man. A ship ordered to be sent to stop the tide, and dam up the mouth of the haven.

They continued working eight years, and spent 6000*l.*, besides the 50 marks remitted, when they found it never could be made an entrance, and it was stopped up with large faggots; but within 14 days the wind and a raging tide, and also the back waters, caused the water to flow over the quays.

They were forced to draw the ships over the Denes. Mr. Drury, of Aylsham, consulted.

2 Eliz., 1561.

Another haven cut, probably the present one; the populace assists, standing up to the middle in water. 14 March, the water run forth, and proved a good haven, with 10 *feet at low water*. The next assembly, it was ordered that carpenters should form a *pier* to prevent the passage of the water under the cliffs, and that the ruins of the church of Our Lady at Southtown should be used to fill up the pier.

3 Eliz., 1562.

Certain persons went to Embden to confer with a person learned in such works.

The pier straightened.

5 Eliz., 1564.

Two tumbrels ordered, and a house for the workmen.

Jan. 1566.

A certain Dutchman, named Joas Johnson, was brought over, who on 5th May began to work on the north side of the haven, where he caused stakes to be driven so as to make firm ground.

On the 15th of June he wrought on the south side to force the tide to run out to the north-east.

10 Eliz., 1567.

License from the Queen to transport 18,000 quarters of wheat, barley, and malt, making in money 1407*l.* 8*s.* 7*d.*, which being expended, they had from—

	£.	*s.*	*d.*
County of Norfolk	307	10	6
" Suffolk	70	14	5
" Norwich	85	12	2
" Clergy	39	6	10
	£503	3	11

Collected in 1573, 1574.

18 Eliz., 1576.

Granted transport of 10,000 quarters (1073*l.* 5*s.* 6*d.*) of barley and malt; also, a loan from the city of London of 1000*l.*, to be repaid by 200*l.* per annum.

22 Eliz., 1580.

Granted transport for 50,000 quarters barley, making 2720*l.* 5*s.* 8*d.*

26 Eliz., 1584.

Granted transport 40,000 quarters as before, 1721*l.*

36 Eliz., 1594.

Granted 1000*l.* from the Customs, by 120*l.* per annum; 50 marks fee-farm rent for 40 years.

No. 243.
Labelye's Report of a View and Survey of Yarmouth Haven.

No. 243.

The Result of a View and Survey, &c., of Yarmouth Haven, by CHARLES LABELYE, C.E.

Crown Court, King Street, Westminster,
18th January, 1747.

GENTLEMEN,

I HAVE taken, at your desire and request, in the months of August and September last past, a view and survey of your haven, piers, Braidon Waters, the rivers Wavenny, Yare, and Bure, dis-

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charging themselves therein, and the adjacent parts of the country, of which a correct map (as taken in the month of April last by Mr. Richard Paton) is hereunto annexed.*

From the several views, measurements, soundings, and observations, which I have taken, I am enabled to acquaint you in this following Report with the true state of your haven, and to point out the methods which, after mature reflection and consideration, do appear to me the most eligible to restore your haven to its former good condition, and even to improve it, especially at its entrance, without attempting to force nature, or entering into dubious and expensive undertakings, in order to which, and for the greater perspicuity, give me leave, gentlemen, to divide this Report under the three following heads:—

1st. To relate, in as few words as the subject will admit of, the true state in which I found the bar, haven's mouth, basin, quays, wharfs, bridge, Braidon Waters, and the Three Rivers, together with my observations and remarks thereon.

2nd. To point out what I humbly conceive you ought to avoid, or not to do.

3rd. What methods, in my humble opinion, ought to be pursued, not only to obtain the desired restoration of the haven to its former good condition, but also what may be done towards the improving it still more, as far as the nature and circumstances of the place will permit.

1. I carefully viewed and examined the haven's bar, which during all the time of my survey reached quite across the haven's mouth, at the short distance of a cable's length, or about 200 yards from the pier heads: I observed with concern the dangers and difficulties attending the ships and vessels getting in and out of the haven, over the said bar, though the weather at that time was very moderate, and from what I saw then, I easily conceive how much more dangerous the said bar must be in more stormy weather. I found this bar to consist of some beach-stones or shingles, but chiefly of a very fine loose sand, the same as all the shoals and banks which lie in and about Yarmouth Road, and all the adjacent sea coasts; from thence and all other circumstances, such as the winds blowing on or off the shore, or along it, and the greater or lesser quantity of land waters, emptying themselves out of the haven's mouth, I plainly perceived that this bar must often change its size and position. I found it accordingly very different from what it was in April last, and was informed it was almost daily altering, as to shape, size, situation, and shoalness.

2. I took particular notice of the position and construction of the old south and north piers, and of the additions made to them since: I found the old south pier still filled up and tight, and therefore still answering the chief intentions for which it was built, viz., to hinder the waters of the three rivers and the Braidon from running to the southward, as they used to do before under the highlands, and to turn the stream of the ebbing waters to the eastward; in order to keep the mouth of the haven as open and as deep as possible; but this last intention is at present frustrated in a great measure by the slight construction and bad condition in which I found the new or additional south pier, through which a great part of the ebbing waters escape to the south-east of the mouth of the haven, the new south pier at present being only useful as a platform, or stage, on which, by the help of the capsterns there erected, men are enabled to help the ships in over the bar.

3. I examined the remains of the old north pier, now almost buried in the sands, which fill up above half the channel between the piers, and also the new additional north pier, on which the crabs and capsterns are placed, for the heaving in of ships over the bar, and I am clearly of opinion this is the only use and service that either the old or the new north pier are at present, or ever could be of: I shall speak more largely on them in the last part of this Report.

4. I examined the construction of that wharfing round the elbow of your haven's mouth called the Brush, and find it sufficiently well performed to answer the purpose it was made for, though not placed so well as it ought to be, as I shall show hereafter.

5. I took a view of the fort, but having no encomium to bestow upon it, all I shall add to this Article is, that it must be looked upon as a battery of 13 guns, which, it is to be hoped, will be always kept in good order, and supplied with a proper quantity of ammunition, and all necessaries.

6. I also viewed and examined the south and west shore of the haven's mouth round the fort, and was sorry to find them so incumbered with stakes and jetties advancing even beyond low-water mark, and consequently of great hinderance to the land water scouring the haven's mouth.

7. I observed with pleasure the rise and course of the tides through the said haven's mouth, and found the flood-tide running up the haven between the piers at the rate of full five miles an hour, and the latter end of the ebb, when swiftest, running out between the piers at the rate of full 5½ miles an hour, all which I deduced at a medium of several observations; as to the rise of the tide at the haven's mouth, it may, at a medium, be computed about six feet perpendicular, it being seldom more than eight, or less than four feet.

8. I was sorry to find that the Brush wharfing, being placed too much in the land, and making the turn of the haven towards its mouth much too short, the shoal of sand over against it is advanced from the fort side so very near the said Brush wharfing, and so much contracts the channel, as to render the navigation at that place very difficult and dangerous, ships being frequently aground on the said shoal.

N.B. The haven's mouth being the place, in my humble opinion, where the greatest efforts for restoring the haven to its former good condition (and even improving it further if possible) ought to be made, I took a particular survey thereof, a correct draught of which I have annexed to this Report.

9. The next subject of my survey and observations was the haven itself, contained between the Brush wharf, or the Fort and Yarmouth town, and I observed with a great deal of pleasure its considerable length of near two miles, convenient breadth, and depth of water, even very close to low-water mark, all which make it a most safe retreat and wintering place for a very great number of ships and vessels at the same time; and though these ships and vessels are not of the greatest draught of water, it is with such ships and vessels that above three-fourths of all the sea trade is performed all over the world: therefore this haven, in my opinion, wants only an easier coming in and going out, and to be kept from being silted up. In my frequent goings up and down this haven, I could not but take notice of several jetties extending from the shore even beyond low-water mark erected for the shipping off goods, or for the conveniency of landing with boats and passengers; two of these are near the Fort, and several others on the opposite shore further up, all which are very prejudicial to the free course of the tides and land waters.

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* None of the maps or plans referred to in this report are at the present time in the possession of the Haven and Pier Commission.

APPENDIX B.

GREAT YARMOUTH.

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Labelye's Report of a View and Survey of Yarmouth Haven.

Further up, at the lower end of what is called the Ballast Quay, I examined the engine for taking up sand and mud, in all its parts, and afterwards had also a view of the model of it in town: from what I saw of its construction, and from what informations I had of its performance, I think it a very good engine; I shall mention hereafter how and where, in my opinion it ought to be used, and shall conclude this Article with observing, that as almost all the different motions of this engine (which being pretty much complicated, are not a few in number) are performed by wheels and pinions, I should suspect the contriver thereof to have been either a clock-maker or a jack-maker; and that from the make and construction of the paddles or buckets which rake the bottom of the river, when the engine works, it does not appear to me that any hard gravel or clay, or even solid earth, could be effectually taken up by this engine.

10. Proceeding further up, the next object of my survey was an exceeding slight kind of wharfing which I observed on both sides of the haven, but more of it on the east side, made up of a few stakes and deal boards; these wharfings, I was informed, were intended for a double service, to preserve the main lands and roads on each side from the lashing of the waves in rough weather, and also to contain the stuff which the engine was to take up, and keep it from returning into the said haven; but the slight deal boarding fastened to the stakes of this wharfing, not being carried into the ground something deeper than low-water mark, as it ought to be, on the contrary, being left off at some distance from the surface of the ground under it, whatever sand, mud, or silt is thrown beyond it, will soon be washed out again, through that opening at bottom and the main land, or the road on each side of the haven, are now almost as much exposed as if no such trifling wharfs had been erected.

11. I could not help also taking notice that what is allowed to ships for ballast, being chiefly small sand which I observed to lay in heaps very near the water on the said Ballast Quay, fresh gales from any point in the eastern half of the compass must in dry weather blow a considerable part of this sand into the haven, which being carried up and down by the tides, must contribute (at least in some measure) to the silting up of the haven, and increasing its shoals; but I shall in the last part of this Report propose an easy remedy to this evil.

12. I now come up to that part of the haven which is the most beautiful, as well as the most in use, ranging along the west side of the town of Yarmouth, and parted from the houses by one of the finest and most convenient quays in the whole world. I was mightily pleased to find so much depth of water in the channel of this part of the haven, (which for distinction sake I call the Basin, or the Pool,) and so good a stream to keep it clear.

13. I am obliged to mention that I found the wharfings of your quays, and those on the opposite shore, in a very bad condition; great part of them in want of considerable repairs; some quite ruined; so that till repaired, part of the very quay will be daily washing and crumbling into that beautiful and most useful basin. Moreover such parts of the quay wharfs as are tolerable good are built in several bends and angles which are very prejudicial, by giving room to the mud and silt to lodge there, and accordingly I observed a considerable quantity of that kind of silt, almost all along the wharfing of the quay on Yarmouth side, and was credibly informed that it was much increased of late years. This is no more than a necessary consequence of the decay of the wharfs, and the improper manner of repairing them, and is of considerable prejudice to the shipping, which cannot approach to the quay at present as they did heretofore.

14. The next thing which offered in the course of my survey and observations, is Yarmouth bridge, which I found so far decayed in all its parts above low-water mark, as well piles as upper works, that I do not conceive your communication for carriages with Suffolk can be preserved long without very considerable repairs, or rebuilding it quite new; from my own observations, and the best informations I could procure, I find that the rise of the tide, under the bridge, cannot be computed (at a mean) at more than three feet perpendicular, it seldom rising less than one foot on extraordinary neap tides, or more than five feet on extraordinary spring tides.

15. I could not help taking notice that the river Bure, commonly called the North River, enters the Braidon in a direction almost contrary to the course of the waters of the two other rivers; such a direction must almost necessarily occasion that shoal which is now in the Breydon, just below the entrance of the Bure into it, and having been informed that it has increased considerably since the wharfs and building near the entrance of the Bure into the Braidon have been advanced into deeper water, if upon proper inquiry the truth of this should appear, all such advanced wharfs ought to be looked upon as very prejudicial encroachments, and removed if possible.

16. The next subject of my observations was, that large receptacle of waters called the Braidon: besides the advantages accruing from the fish and fowls, which it affords in plenty, it is certain that all such large receptacles of waters, situated above harbours, in and out of which the tides have a free ingress and regress, are always of the greatest advantage to those harbours, in receiving and containing large quantities of waters, part of which serves as back waters jointly with that of the rivers, which empty themselves through it, towards scouring the haven, especially at the mouth thereof, and towards preserving a good depth of water. As I shall explain the use of the Braidon more at large in the latter part of this Report, I shall only observe here, the rise of the tide in this large lake must be greater or less in different places, according to their distances from the haven's mouth: it may be computed at a mean, at about two feet perpendicular, all over the said Braidon, it being seldom less than one foot in neap tides, and seldom more than three feet in spring tides. I found the channel through which the navigation of the keels, and other vessels is performed, between the haven and the three rivers, convenient enough for that purpose, excepting only over-against Red Coat Point and thereabout, where, for want of a sufficient depth at low water, some of the vessels cannot pass without difficulty; to remove which, I shall mention the only remedy I can think of hereafter. I was informed that of late years the Braidon has been considerably silted up, the shoals therein having increased, and remaining dry or bare longer than they did; but this happens to all rivers and streams after a course of dry years, and the reverse, viz., the shoals growing less, and the depth of water increasing by the scouring of the rivers, after a course of wet years.

17. Under this last Article of the first part of my Report, I shall lay down promiscuously all the material observations which I made on the three rivers, the Wavenny, the Yare, and the Bure; the first and last of these I carefully viewed, and observed, to the extent of Yarmouth jurisdiction, viz., up to St. Olave's Bridge, and up to Wey Bridge; the second I carefully observed not only up to Hardley Cross (the extent of that jurisdiction), but quite up to the city of Norwich; I found, in general, each of those three rivers very beautiful, and very commodious for the navigation of a very considerable breadth, and having each of them great depth of water, not only in the best of their channels, but even very close to the shores or banks: from my own observations, and the best informations I could collect,

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I don't find them obstructed with any considerable shoals, not even at the points of their several reaches, or turnings, where it is very common to meet with such shoals, but I found them indeed in several places too full of rushes and weeds. As to the rise of the tides in these, as in all other tide rivers, it is more or less, in different places, according to their distances from the sea; but in order to fix upon some place that may serve as an average on the whole, I found from my own observations, and the best informations I could get, that about the extent of Yarmouth jurisdiction up those rivers, viz., at St Olave's Bridge, Hardley Cross, and Wey Bridge, the rise of a common tide cannot be computed at more than one foot six inches, it flowing seldom less than one foot or more than two in those places, and less and less higher up, to the utmost extent of the impulse which the flood-tides receives from the sea.

I determined also (at a mean), from several observations, the greatest velocities of the stream of each of those rivers, near their entrances into the Breydon, but was sorry to find them all so very gentle: the Bure is the swiftest of the three, and the Yare the slowest, and none of the three runs much more, or much less, than about one mile an hour; I plainly saw the reason of so gentle a current in all those rivers, by observing how low and level is the greatest part of the lands through which they pass, which in many places are not higher, not even so high, as the high-water mark of spring tides, and in the driest places but a very few feet higher, and therefore it is no wonder that great part of those lands are so often overflowed by extraordinary tides and considerable land floods. I cannot conclude this Article without observing, upon the whole, that the Yare appears to me the finest and best of these three rivers, and of the greatest consequence, for I found it very navigable for considerable vessels quite up to the city of Norwich, and am informed that it is still so for many miles up higher into the country, and up into other streams and rivers which empty themselves into the Yare, to the inestimable advantage of that large city, and all the neighbouring countries.

Having gone through the first part of my Report, which was to contain the result of my view and observations, I now proceed, gentlemen, to the second part, wherein I intend to lay before you the absurdity of some notions, and the impropriety or impracticability of several schemes or projects that have been mentioned to me more than once, with my reasons for exhorting you in the most earnest manner never to give your consent for putting any of them into execution; I think it is proper that this part containing what, in my humble opinion, ought to be avoided or not done, should precede the last part of this Report, wherein I shall propose to you what, in my humble opinion, may and ought to be done, because the first step towards doing what is right is undoubtedly to avoid doing what is wrong.

18. In the first place, gentlemen, you ought never to entertain any notions of altering the place of the mouth of Yarmouth haven, in order to have it either further or nearer the north or south end of Yarmouth town, for it appears by the records and the haven's books, that between Edward the Confessor's reign and the year 1560, when the first south pier was ordered to be built, that there have bean eight different entrances into Yarmouth haven, and that the present has been the best, and continued the longest in a good condition without a bar, to the restoring of which (or to the improving it into a better) all possible endeavours ought chiefly to be employed.

19. The next absurd notion (which ought to be for ever rejected) is, that Yarmouth Haven can ever be improved so as to admit ships of war, or of very considerable draught of water, or that dry docks can ever be constructed about the haven wherein large ships might be built or repaired, which upon the opening of some gates, the tides would bring in, or fetch out, whereas the rise of the tides on your coast, and in your haven, is not considereble enough for any such undertakings; notwithstanding which the haven is certainly good enough to promote a very extensive and beneficial trade, and (with due care) it may be further improved; of which more hereafter.

20. Another notion, which in my opinion ought also to be banished out of the minds of all reasonable people, is, that there may be a probability of certainly preventing at all times the mouth of Yarmouth Haven from having any bar or shoals before it, on which it must be observed that all rivers whose beds are not entirely rocky bring down with them some silt, or earthy particles, from the lands which they run over, and that the velocity of their streams being not only much retarded, but entirely stopped very soon after they enter into the sea, whatever those rivers bring must necessarily drop thereabout, in shoals and bars, some of which are fixed, and others moveable, according to the different nature of the soil and other circumstances attending different rivers; but besides this general reason for there being frequently a bar, or some shoals more or less, before Yarmouth Haven, it is well known (at least to all seafaring people on your coast) that your bar, and all the shoals and sands in and about Yarmouth Road and coast, are not altogether brought ought of the lands, for all or most of them consist of some shingles or beach stones, but chiefly of a fine small sand, very loose and easily moved about by the winds, tides, and land-floods, which, according as those different causes act jointly or contrary, must necessarily change the shapes, sizes, and situations of all or most of those sands, as well as that of Yarmouth Bar. Now it is impossible, since several of these causes, which contribute towards forming the said bars, shoals, and sands, are not at all in men's power, that your bar can be always and certainly removed by any possible disposition of your land-waters and back-waters, which are only one of the several efficient causes that contribute towards the making or the removing those bars and shoals. I shall, in the last part of this Report, offer you my opinion as to the best method of applying your land-waters and back-waters, so as to obtain the most that can be expected of them, towards the removing the said bar and shoals, or at least towards keeping some passages open through them.

I cannot leave this subject without taking some notice of a project which has been mentioned to me as an infallible, or at least a very probable expedient to remove this bar; but in my humble opinion it ought never to be put into execution, since it would be attended with a very great expense, require a great deal of time, and, at last, nowise answer the end. This project is, to lengthen the south pier of Yarmouth Haven further into the sea, to place the additional part so as to point towards the north-east, and, lastly, to make it so tight all the way as to force the course of the land or back-waters to the north-east, by which means the proposers expect that the land or back-waters so directed will certainly be able to carry away all the bar and shoals which, as they say, are brought to the haven's mouth chiefly from the north-east by the tides of floods. It is certainly not only possible but practicable to put this scheme into execution; though, I am afraid, that few of the persons who propose, or approve, or espouse it, are aware of the time, trouble, and expense, that must attend such an undertaking; but I am convinced that, from the execution of this additional pier, the bar and sands would not be removed, and the entrance of the haven would then be more difficult than it is

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now; for supposing it were true, which I am far from believing, that the bar is chiefly brought on by the flood-tides from the north-east, the consequence necessarily attending the execution of this scheme would be, that the force of the land or back-waters, already greatly lessened by the short turn they must take round the Brush Wharf, from what it would be if it went out at sea without taking so short a turn, would still be lessened much more by meeting another angle or bend at the end of the present new south pier; and though the land or back-waters would go on then in a direction towards the the north-east, it so happens that at the time those waters can act at all, viz., at the latter end of the ebb, the moment they should have passed the end of this new south pier they would be checked by the ebb-stream setting to the north, whence it is evident to any person that understands the effects resulting from two forces acting jointly in different directions, that the action resulting from these two forces must be in a direction tending to some point between the north and the north-east, and exactly due north-north-east, if the force of the land-waters was always equal to that of the ebb-stream; but as the force of the land-waters would grow weaker and weaker the further it went from the pier, and that, on the contrary, the force of the ebb would remain the same, the direction of the back-waters would soon be nearer to the north than north-north-east, and very soon after bend still more to the north, along the shore, where only there would be a possibility of any channel being kept open, and such a channel would make the entrance of the haven still more difficult, and still more liable to be choaked up, and altered by the flood-tides, than it is now, especially with fresh gales from the north-north-west to the north-north-east.

21. The next caution which I think my duty obliges me to give, is to prevent, by proper informations, some persons confounding or mistaking what are properly the back-waters of Yarmouth Haven with what are not so. To avoid this it must be observed, that in all such parts of the rivers or streams where the tide never reaches, all the waters that run down may be looked upon as land-waters, or back-waters; but in any place where the tides are felt, what can properly be called land-waters or back-waters is only the overplus by which the waters that passes or run down in the ebb towards the sea exceeds the quantity of waters that passed or were forced up during the preceding flood.

Now as the tides of flood and ebb, in all rivers are not equally strong, that is, have not the same velocities nor indeed, have either of them the same velocity from beginning to end, it is not easy to determine this quantity of back-water very exactly; but for an average sufficient for all practical affairs and computations, the quantity of back-waters which passes through at any one place may be computed to be not very different from what passes through that place at the latter end of the ebb during that time by which the ebb-tide exceeds the time of the preceding flood. For example, at Yarmouth Haven pier heads, where the flood-tide is, in round numbers, usually five hours making up, and the next ebb about seven hours going down, the water that goes out at the haven's mouth during the two last hours of the ebb is nearly all that can be properly called the land-waters or back-waters. This distinction, well understood, will show the reason why there are many places which, like Yarmouth Haven, have a great deal of water above them, and yet, on account of a scanty rise of the tide, or rivers running but slowly, or other circumstances, have but little useful back-water for the scouring of the channels and mouths of those havens or places.

22. The next scheme or project, gentlemen, which I can never caution you too much against, is the erecting of locks and sluices across your haven, or across any of the rivers. I know very well that such schemes appearing at first view plausible enough, and carrying along with them the appearance of a double advantage, viz., the increase of back-water to scour your haven's mouth, and also the keeping extraordinary spring tides from overflowing some low lands, is the reason why such projects meet with abundance of friends; but I hope that those persons will be no longer of the same opinion, after reading and considering what follows.

There are several kinds of sluices, all of them invented within two or three hundred years, and most of them by the Dutch; some to keep the sea out, and at the end of the ebb, to let out their land-waters; some to receive and keep in the sea or tide-waters, to serve as a back-water, either alone or jointly with some land-waters, by being let out suddenly at low water; some are so constructed as to be able to answer either, or both these purposes; and lastly, there are other kinds of sluices of the greatest service in making the inland rivers navigable, so contrived as to let vessels pass through, and to rise or depress them from the level of one part of the river to the next; such sluices are called in the Fens, Penstock Sluices, and in most other parts of England, locks. Now, as to the practicability of this project, it must be observed, that the only places where any intelligent person would place such sluices must be either at the upper end of your haven, above the bridge, where it could be made to pen up all the waters brought by the tide into the Breydon, and the three rivers, besides the land-waters; or else, if that be thought too difficult, or too expensive an undertaking, the most likely place for such sluices would be at the mouths of all the three rivers, just above their entrance into the Braidon. Of these two situations, the first is certainly the best, since not only the extraordinary high tides could be kept from all your low lands, even those round the Braidon, and all the tide waters brought in by the flood-tides into the Braidon, and the three rivers, might be employed jointly with the land-waters, as back-waters.

But let it be considered that the space to be sluiced in that place is near 200 feet wide and near 25 feet deep at low water in the middle, and the nature of the soil at the bottom and sides being, as I was informed, mostly sandy, the difficulty and expense that would attend the execution of such a project would be immense; for it is my duty to inform you that the building of good and substantial locks or sluices, especially in such depth, and in such sorts of ground, is the most difficult part of all practical engineering—the most expensive, the most dangerous, the most liable to unforseen and often irretrievable accidents—and in such a place as I am now speaking of, extremely difficult to be repaired or mended, when the works first erected should come to decay. To this must be added, the expense of a lock or Penstock sluice, for the sake of navigation, which it would hardly be possible, and not at all advisable, to construct in any part of the sluices that should bar your whole haven, and consequently such a lock must be erected upon a side cut which must be dug out either on Yarmouth side, where there is but little if any room for it, and what must be very dear, or else on the opposite side, where the ground seems to me very indifferent for it, without great additional works to secure the foundations, as well as the bottom and sides. What I have now mentioned of the difficulties and prodigious expenses attending the sluicing your haven holds equally true if the sluices were erected at the mouths of all the three rivers: for though the depth of water is not so great there as at the upper part of your haven, it is still very considerable in each of them, and the breadth of those three rivers, taken together, much larger than the breadth of your haven, and the nature of the soil, as I am informed, not much better,

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to all which must be added, in this case, three side cuts, and three locks or Penstock sluices, one on each of the rivers, for the sake of navigation.

But besides my putting you on your guard as to the difficulties and expenses attending either of these projects, I must next inform you how little good they could do at most, and, on the contrary, how much mischief they would certainly occasion; either of these two projects would indeed increase your back-water, but not so much as some may imagine; for supposing everything as much as possible in favour of them, that is, supposing the real natural back-water to be what runs out for the last two hours at the end of the ebb, and that it runs all that time at the rate of 5½ miles an hour, which it certainly does not, and that the tides rise to the utmost of what I have mentioned in the 7th, 16th, and 17th Articles of this Report, I can make it appear to any person sufficiently versed in these kinds of computations that all the waters penned up in the Braidon, and three rivers, would not increase the velocity or the duration of your present back-water in the proportion of two to three, and that if the sluices were placed at the mouths of the three rivers, the back-water would not be improved, in either duration or velocity, in the proportion of four to five, nor perhaps in that of five to six, either of which, in my humble opinion, is not worth while to be sought after at so great a risk and expense, especially if the danger you would then certainly be in, of utterly losing your haven in a few years instead of improving it, be also taken into consideration; for in general, though locks and sluices are one of the most useful inventions of the moderns, and of infinite service to mankind in the making of inland rivers navigable, they ought never to be placed in the way of tides, without the utmost necessity. In inland rivers, indeed, where the waters are kept stagnating, or nearly so, upon different levels from one loch or sluice to the other, it is observed that the lochs or sluices are of no prejudice to the rivers all the way above the lowest loch, if there be more than one; but it has also been often observed, that sluices or lochs placed within the reach of the tides have occasioned the rivers or streams on which such works were erected, to silt up from the sea to the said works. It is chiefly owing to these sorts of works, together with the embanking of marshes injudiciously, that the town of Rye and the town of Wisbeach are, from seaport towns, become, as it were, inland towns, having in a great measure lost their havens; and in my opinion there is no need of looking out for more reasons of what is confirmed by experience than the following one, viz., that nothing is more certain than that the greater is the quantity of water, and the oftener it passes and repasses through any channel, the cleaner and deeper that channel is kept, whence it happens that all rivers, especially tide rivers, are more or less silted up after a course of dry years, and that they recover, and often increase in their depth, after a course of wet years.

I am sensible, however, that the keeping low lands from being overflowed by raging spring tides is an object worthy of attention, especially to the owners thereof; but if I am not mistaken, the low lands about the Braidon and the three rivers, are oftener drowned by the land-floods than by the tides; nay, if it were otherwise, I presume all good people will join in my opinion, that it is better that some lands should be now and then made too wet, by the tides coming in, than that, by the tides being shut out, the haven should be in manifest danger of being lost.

Were it possible, indeed, to restrain only the very top of those raging tides, which only do mischief to the lands they overflow, without improving the back-waters, by reason that little or none of the waters flown over those lands do return towards the sea, but remain there stagnating till evaporated by the action of the sun and winds: I say where such a thing is practicable, that restraint is productive of good instead of evil; but there are very few situations that will admit of it, and I have not met above one in twenty-five years' practice and observations. I think, upon the whole, all locks and sluices, in your case, the most pernicious of all schemes; therefore I earnestly advise, and humbly hope, that if the town of Yarmouth, the city of Norwich, and all the neighbouring countries who are concerned in this haven, have any regard to their own present and future welfare, they will always steadily oppose and hinder, to the utmost of their power, the execution of all such works.

Meers and lakes.

23. Another scheme has also been mentioned to me, which I think it my duty to caution you against, lest a great deal of time, trouble, and money should be thrown away to little or no purpose at all; and this is, to open some channels of communication between all the meers, lakes, or broads in your neighbourhood, and some of the rivers emptying themselves into the Braidon, by which means the persons who propose this scheme are, if not certain, at least in good hopes that there would be a considerable increase of back-waters towards the more effectual scouring of your haven, and removing the bar from before its mouth. A laudable proposal indeed! if the situation of all those broads were not so low as they are, and if those broads or collections of waters were anything more than the draining of the rain waters, with some few inconsiderable springs or rivulets. In my views of the Bure and the Wavenay, I took notice of two small channels overgrown with rushes and weeds emptying the waters of two such broads into those rivers; the one they called Muckfleet, the other Fretton Decoy; and I heard some persons affirm, that were even only those two channels opened, so as to admit the free ingress and egress of the tides in and out of those two broads, great benefits would accrue therefrom to your haven.

Now, though it is certain from the very first principles of hydrostatics, confirmed by daily experience, that all reservoirs or receptacles to receive the tidal flood are certainly of great service to increase the back-waters of any harbour, yet the chief thing to be inquired into, before any such reservoir be dug out or made use of, is, to what height above the low-water mark, at their mouths, the tide is likely to rise up into them, since the greatest benefits to be expected are not from the largeness alone, or from the number of those broads, nor from the depth of their waters; because all the waters contained in them, below the low-water mark at their mouths, is of no more use than so much dry land; but from the height to which their waters are usually kept up above the said low-water mark, by springs or rivulets, or else from the height to which the tides would rise up into them. Now, from the low situation of all the broads in your neighbourhood, it is not very difficult to conceive what would be the consequence of not only Muckfleet and Fretton Decoy, but several other broads, being made to communicate with your rivers, for the result would only be this; if the surface of any of them lie lower than the surface of high water at their mouths of communication with your rivers, in less than 12 hours they would be filled to the same level as the rivers at high water; on the other hand, all those broads whose surfaces are higher than that of high water at the mouths already mentioned, would, in less than the compass of two tides, or about 12 hours, empty themselves into the rivers, till their surfaces should all be about the same hanging level as the surfaces of those rivers, and ever after would afford but a very small addition of back-waters to those very rivers, for the whole of it would only amount to that small remainder of what the tides could bring up into them at every flood, which should be there left, within about two hours before low water; and since the tide rises but to a very

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inconsiderable height up into your rivers, my humble opinion is, that the greatest benefit that ever can be expected from the opening of communications between all the broads about your country and the three rivers, would at most be very inconsiderable, and will never answer the expense.

24. The last project or scheme which I have heard mentioned for the improvement of Yarmouth Haven, is that of cutting a new and much shorter channel for the Bure or North River into the Braidon, at a place called Scar Gap; now supposing it were done, the consequence would be, that it would be high water at every place in the North River above it where the tide reaches a few minutes sooner than it happens now, that the river is obliged to take a round-about course by the north-east end of Yarmouth town, but the tides would not thereby reach one inch further up, or rise at any place one single hair's breadth higher, because the forces of the tides are always as the impulse they receive from the sea, which enable them to rise into the rivers to a certain perpendicular height at every place where they reach, and no higher, whether the tide is a longer or a shorter time in reaching up to it, and therefore since the tides would rise no higher, nor flow further up into the Bure by the new cut proposed at Scar Gap than they do now up the present channel, and moreover, that the velocity of the ebbing waters of the North River would be as soon lost by falling through the new cut, and dispersing themselves into the Braidon, as it is at present, I believe all unprejudiced persons will be of opinion with me that such cut would not only be of great prejudice to the north-east end of Yarmouth town, to all the buildings and lands above it, as far as Scar Gap, and that the money that must be laid out in indemnifying the owners for their loss, in the purchase of the lands for the new cut in the making this new channel and stopping up the old, should only be money thrown away.

Gentlemen, having now gone through the first and second parts of this Report, I shall proceed to the third and last part, wherein I propose to lay before you what steps, in my humble opinion, ought to be taken, and what works should be put into execution, as soon as possible, in order to preserve and improve your haven.

25. From a careful view and survey of your present haven's mouth, the nature and situation of the neighbouring parts, and all other circumstances, it plainly appears to me, why, till the land waters and floods, with the returns of the ebb tides, were effectually hindered from escaping along shore to the southward towards Lowestoft, under the high lands of the coast, and were turned right out to sea by the building a south pier, all former havens were lost, or rendered useless in a few years; in which opinion I am confirmed by some abstracts of your records and haven books, which I have seen, which show that the first substantial south pier was not begun before the year 1560, that an open north pier was constructed soon after, and that while they were both kept in good order, and in the same state and condition in which they were first built, the haven was in as good condition as could be wished, and remained without any considerable bar for nearly 100 years, consequently nothing appears to me clearer than that your chief care ought to be to repair, in the first place, the new south pier in a strong and substantial manner, so as to answer those very purposes for which it was built, viz., to hinder the waters from passing to the southward, and to direct them right out to sea, for clearing the mouth from bars and shoals as much as possible, or, at the least, for keeping open some passages through it.

The method which I recommend to be followed in doing this is the following; first, to draw out all the large piles round the said new south pier, which shall appear too far decayed, and to drive new stout oaken ones in their stead, something deeper than the old ones were, with a weight called by some a ram, and by others a bell, not less than 12 or 14 cwt., and the strokes not less than 15 or 18 feet high at an average. Secondly, as the row of split piles, which are driven in the inside of this pier the whole length thereof nearly parallel to its sides, but (I know not why) twice as near to the north than to the south side, is now greatly decayed, and several of the piles washed out, the said row of split piles ought to be put in thorough repair and made as tight as possible. Thirdly, in the inside of this new south pier, close to the outer piles, on the north and south sides, and in the middle line between the present row and the south side, three other rows of split piles should be driven at least 10 or 12 feet deep below the low-water mark. Fourthly, at the east end, and close to the west side of the rows of piles, which support the cross beams of the pier, cross rows of split piles should also be driven, as close to one another as possible, to the same depth as is just now mentioned, by means of these four rows of split piles, viz., three new ones besides the old one mended, each of which will then extend the whole length of the pier, and by means of the several cross rows of split piles, the whole cavity of the new south pier will then be divided into several smaller cells or cavities, nearly square, or oblong square, as I have represented in No. 2 of the draught annexed, which is edged with blue silk; wherein, for distinction sake, part of all the present old works are marked in Indian ink, and the new rows of split piles which I propose are marked in yellow. Fifthly, as no care or expense ought to be spared to make this additional south pier, as well as the old south pier as tight and as strong as possible, I do not think all these rows of piles sufficient, but would recommend to take up all the sand out of those cells or cavities in the pier to low-water mark, and even some feet lower, and to have them entirely filled up, not with sand or rubbish, but with such a substance as will suffer no part of the sea waters or the ebbing waters from gulling under or passing through. After mature reflections upon the materials that can most conveniently be had, and employed for this purpose at reasonable rates, the best and cheapest I have to propose is a kind of stone-mortar, made up of a mixture of beach stones or coarse ballast worked together, before it be put into those cells, with the strongest lime that can be had at a moderate price: the best size of beach stones for this purpose are, none to be less than a small nut or filbert, and none much larger than a hen's egg; but without being so nice as to the picking of them, common large course ballast will do full as well, provided it be not intermixed with too much sand, or other small stuff; as to the lime, it is certain that Dutch tarris, mixed in a proper proportion with common lime, would be the best to work up this stone mortar, but as it would make this part of the work very dear, I shall propose to you another sort of lime, which I have reason to think will do full as well, and that this is shell lime mixed with other lime, in a proper proportion, which the persons employed about this kind of masons' work will soon find. This kind of lime, viz., shell lime, has been but lately made in any quantity near Gravesend, what was used of it in England before being chiefly imported from Holland, where great use is made of it in works of this kind, as well as in the East Indies and several other places; and I have reason to think that it will answer very well for the purpose of filling your pier, as it is to be had near the mouth of the Thames, and may be brought to the very spot by shipping, it will come at a very reasonable price. If I had not this shell lime to recommend in the stead of Dutch tarris, I had mentioned some sorts of strong stone lime; but as there is none to be had near you, nor indeed can any be had so good and so reasonable. I forbear adding anything more

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to this article of the lime than to observe that even the best of chalk lime alone will not be good enough for this purpose, and that great care ought to be taken lest the shell lime which, I recommend to you be not too much weakened by using with it too great a proportion of chalk lime, or even stone lime; I doubt not but several readers will be surprised at this stone mortar, or mixture of beach stones or coarse ballast and shell lime which I propose for the filling of the cells or cavities of the south pier, but the use of it is far from being new, or in anywise extraordinary. The Romans, and since them the moderns, having made use of it frequently and with great success, and little expense, of which I could mention if necessary a great many instances, and quote about it the authorities of many celebrated authors besides that of Vitruvius. Moreover this method is particularly adapted to the making of good and cheap work, in the affair of filling your pier, because the whole cavity being divided into several cells, they are severally managed with great dispatch, conveniency, and little waste, the split piles hindering the water, in a very great measure, from washing away the best and most fluid part of the lime contained in this stone mortar or mixture, from among the beach stone or coarse ballast, before the whole has acquired some hardness. What I have to add in relation to the new south pier is, that the repairs, and the new works which I proposed, if they be duly managed, will not hinder the use of the capsterns erected at the end of it, for the heaving in of ships over the bar, even during the time that these works are performing: now whether it ever was absolutely necessary to lengthen either of your old piers, or the south pier in particular, is not at all clear to me, from the abstracts which I have seen of your haven's books and town records, neither do I think a minute inquiry into it at present of any great service, my humble opinion of this new south pier being, upon the whole, that since the sands have gathered to the south side very near as far out as the head, and that without such a pier it would be very difficult to heave in the ships till the sands are removed, this new south pier ought to be preserved and improved by proper repairs and new works as explained above; but I cannot advise the lengthening of it further into the sea on any account, either in the same direction which I think the best, or in any other, since if any such addition be made, tight and close, as the south pier of your haven should be all the way to the end thereof, let it be continued ever so far, the ebb-tides and winds will in a few months heap on sands on the south side thereof, which in time will reach quite to the head.

26. From what I could observe of the construction and present condition of the old south pier and of the wharfing round the lowermost elbow of the haven, called the Brush, and from all the informations I was able to collect about them, it appears to me that the said old south pier was judiciously placed, as to its direction, that is, right out to sea, and exactly in the middle between the directions or the settings of the tide of flood and ebb—that it was certainly built in a strong and workman-like manner, and appeared to me still in a tolerable good condition; therefore, all that I shall advise on this head is that, after the new south pier has been repaired as I proposed, the old south pier should next be carefully examined, and put into thorough repairs, by taking up the large piles in front that should be found decayed, and new ones driven in the room of them; the decayed logs and brush-wood behind them should also be removed, and new put in, observing always in this kind of wharfing to use next in front the stock ends of the largest logs that can be had, and to fill their interstices as close as possible with lesser stuff or brush-wood, and what I have now mentioned in respect to the old south pier is also to be observed in respect to the repairs of the brush-wharfing round the elbow of the haven, which ought to be taken in hand, next to those of the old and new south piers.

The said brush-wharfing appeared to me well enough performed as to workmanship, and to be still in good order, but as to its situation and shape, it bends in a great deal too much to the south-west, which occasions a considerable part of the force and velocity of the ebbing waters to be lost, by meeting with so direct an obstacle, and a great quantity of sand, mud, and other silt has thereby an opportunity to lodge in the bend thereof, and it also occasions the point or shoal of sand over against it to advance much further into the channel from the fort side than it would do if that elbows-wharfing had been made in a less crooked direction: and therefore I sincerely advise, whenever this wharfing is greatly decayed, or even before if the necessary sums be not wanting, not to repair it in the same position, but to erect a new one, so that the front of be it according to the position marked in No. 1 of the draught edged with blue silk, by a line of red dots, and to fasten the land ties thereof in the old wharfing; such a new position will considerably increase the force of the land and back-waters, and the shoal off the point would soon be greatly lessened, and perhaps be entirely carried away, to the great benefit of the navigation.

27. Before I proceed to mention my opinion as to what ought to be done with the old and new north pier, I must propose a new work of the utmost consequence, in my opinion, to the security and improvement of the haven; in order to which I must put you in mind, gentlemen, that one of the consequences of shoals and bars choaking all former havens was, as it appears from your records, that the land waters, especially in extraordinary land floods, have escaped to the southward, either at the lowest elbow of the haven, or just above it, over the flats, that lie between the elbow and the high lands of the coast. Now what has happened already may certainly happen again, for from what I observed on the spot, the ground between the Brush wharf, and the neighbouring high lands is still much too low to hinder very considerable land floods from escaping; therefore, I earnestly recommend, as a very necessary work, to secure the haven as soon as possible against the possibility of such accidents; there are, in my opinion, but two methods or ways to do this effectually; the one I shall now mention here, and shall reserve the other to another place of this Report, wherein I apprehend it will come in more properly. The first method is to join the north extremity of the Brush wharfing with the main high land of the Suffolk coast, as I have expressed in No. 1, &c. by a double row of either whole piles, or at least split piles driven in close together, several feet below the level of low-water mark, and in such manner as to break joint; then to the southward of these piles, and close to them, to raise a substantial wall or bank of the best clay, mould, or loamy earth that can be procured, to the height of about three feet above the highest line of the rise of extraordinary floods, observing if such good materials being scarce, you should be forced to use worse, to make the slope next to the piles very gentle as is marked in the section No. 3, in which case the whole ought to be cased or coated on the top and sides with mould or good earth, a foot at least in thickness, which in time will acquire a coat of grass and turf, that will greatly preserve the said bank; but if your materials for the said bank are as good as those I first mentioned, the slope next to the piles need not be made much gentler than that on the south or inside; these two slopes and all the parts are expressed at large in a section thereof at No. 3 of the annexed draught edged with blue silk.

28. In my humble opinion the old north pier was contrived and built very judiciously at first, for as it is chiefly the south pier that forms and preserves Yarmouth haven, by directing the ebbing

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waters right out to sea, the old north pier therefore being built chiefly for the convenience of heaving in of ships, was made to extend at first nearly as far out as the old south pier, but was originally built open in order to give as much free passage as possible for the escape of the sands which are driven along the coast by the winds and tides; and it appears plainly from your records, that soon after the old north pier was filled up with split piles and brush-wood, the sands did immediately lodge, not only on the north side, but in time at the east end, and even on the south side thereof, in the channel between the piers, which is at present above half way over filled with the said sands.

I am sensible that the pretence alleged, among others, for the filling up the old north pier, viz., that the foundation of the fort walls were in danger of being damaged or undermined by the sea, was a very plausible one, but supposing it was true that the fort ever was, or ever should be, in danger from the sea, by any works made for the preservation or improvement of Yarmouth Haven, the Government, under whose care this and all other forts are, has proper officers and servants, whose business it then would be to secure it by chains and fenders of dove-tail and other piles, properly driven round the said fort, at no very great expense; and supposing that this was neglected, or even supposing that the fort should be rendered useless, or entirely washed away, the loss of it would not be very great, and infinitely less as to value and importance to the nation than Yarmouth Haven, for it might easily be supplied by a better, or at least by a battery of the same number of guns.

To return to the old north pier, all I could see of it was in a ruinous condition, and almost buried in the sands, therefore, my opinion is that there is no occasion to meddle with it at present; but in case the methods I shall propose for the preservation and improvement of your haven should have the desired effects, and among others, should clear the channel between the two piers from the sands now lodged there, then, in my humble opinion, the main land round the fort, on the western and southern sides thereof, must be secured with some such a wharfing as the Brush-wharf on the opposite shore, or at least with a row or two of split piles, with a capell, and a sufficient number of land ties properly fastened into the solid ground, which wharfing ought to be placed in a direction nearly parallel to that of the Brush and the old south pier, as I have represented by a row of black dots in No. 1 of the draught annexed, edged with blue silk: this wharfing ought to be carried no further than the eastermost part of the fort walls, or but a little further to the east; and the care of securing the remainder of the solid land round the fort on the north and east sides thereof may be left to the care of the Government.

Moreover, if, as I said before, the sands should ever be washed away to sea from between the piers by the action of the land and back-waters, the remainder of the old north pier ought then to be dug out, or at least sawn as low as low-water mark, and a slight kind of open pier, like your town jetty, should then be built from the place where the wharfing just now mentioned ends, to the west-end of the new north pier, in order to preserve at all times a safe communication with the capsterns and crabs erected on the said new north pier, for the heaving in of ships over the bar.

29. As to the new north pier itself, I am of opinion that whenever it was thought proper to lengthen the old south pier further into the sea, it was also equally proper to lengthen the old north pier, not only for the easier heaving in of the ships over the bar, but because whenever it is necessary to have two piers, whether they be filled up or open at the mouth of any haven, such as Yarmouth Haven, where the tides set nearly along shore, both those piers should be equally advanced, or so as to have their heads nearly in the line of the setting of the tides, and therefore all I have to advance as to the new north pier is, to preserve it fit for the use it is now applied to, and to repair it where wanting, but to keep it, as well as the old north pier, as open as possible, and there is no need of following any other method of construction for that purpose than that of the Town Jetty.

I must also mention in this place, that I observed the remains of another jetty about five or six hundred yards to the northward of the north pier; and was informed that, some years ago, there was another of the same sort, at the same distance, or thereabouts, to the southward of the south pier, but since taken up. As these jetties and all such works are great impediments to the free course of tides, and occasion the lodging of the sands, I earnestly advise to take up the remains of this north jetty as soon as possible.

30. Under the particular name of the haven, I understand the far greatest part of it, contained between the north extremity of the Brush-wharf or the Fort, and the south-end of Yarmouth town; what is lower I call the haven's mouth, and what is higher up to the Braidon, I call the pool or basin. To preserve and improve this beautiful receptacle and shelter for ships, I advise, in the first place, to suffer no new jetties to be built, and to suffer none of those already in being to extend beyond low-water mark, and that if any of them be filled up with brush-wood, or other rubbish, let them be entirely cleared, and kept as open as possible, for if such nuisances are suffered under pretence that they are unavoidable, care ought to be taken to reduce them, and to prevent, as much as possible, the ill consequences that do certainly attend them, which are, that the rivers or harbours do silt up, or what is the same thing, that the depth of water grows less; that the mud and filth increases on both sides, and consequently the breadth of the channel, and of the navigable waters, is thereby lessened; besides these jetties and causeways, I find an old complaint to have been, a shoal apt to gather near the Ballow or Bollard Point. 'Tis certain, that nothing is more common to all harbours or rivers than to have shoals of silt and sand in some particular places, especially off the points which part the different reaches; and the only remedies are, to restrain the stream, or to alter its course, or lastly, to take up so much of it as is necessary for the navigation. As to the first remedy, I shall have occasion to speak of it in another part of this report; and as to the taking the silt up, there is a good engine in your possession, ready built for the purpose, and if that engine be not made use of to the best advantage, it must be the fault of those who make the agreements with the undertakers for the working of the engine and carrying the silt away, or of those who are paid to look after the men who perform the said work. As soon as means are found to set it to work, I advise the management and the working of it to be put under proper checks and regulations, which being done, this useful engine should be at work in all places where it might be found wanting, of which I will set down only four places for your information, that is, the shoal or point of sands between the Fort and the Brush wharf, the shoals about the Bollard Point, the feet of the wharfing of Yarmouth quay and the opposite side, and lastly, the channel for the navigation of the keels and other vessels up the Braidon right off Red Coat Point, and thereabouts.

I mentioned in the 11th paragraph, the inconveniency attending the laying small sand (for the ballasting of ships) close to the edge of the haven, upon what is called the Ballast quay, at the south-end of the town of Yarmouth; and think it my duty to advise, that this work should, if possible,

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be done on the west side of the haven, which is more sheltered from the westerly winds, and from whence the easterly winds could not blow off any part of that small sand and other silt into the haven. I am sensible this might perhaps be attended with some small inconveniences, especially at first, and with some increase of expense in the ballasting of ships; but public good should take place of private interest and all other considerations, though I know it very seldom does.

31. What I have further to offer for the preservation and improvement of that part of the haven which lies before Yarmouth town, and which, for distinction sake, I have called the Bason or Pool, may be comprised under these three articles; the repairs of the wharfs of the quays and the opposite sides, the repairs of Yarmouth bridge, and the removal or encroachments above or below it. As to the first, the corporation of Yarmouth knows whose properties those wharfs are, and consequently who is by law obliged, or who may be obliged (if proper steps be taken) to repair them, in a proper and substantial manner.

As to their construction, I have no fault to find with that already made use of, but I earnestly advise, that the proper officers be enjoined to take care that the repairs be done in a strong and workman-like manner; and that instead of all the bites, bends, nooks, angles, and corners, in which the present wharfs extend, care be taken in the repairs, to join them together without any sharps, angles, or returns, but so as to form a gentle sweep all the way, with as few turns in or out as possible, and as near to a straight line as the nature of the place will admit of.

Moreover, I am of opinion, that those wharfs which are most in shore, and want a thorough repair, or to be entirely new built, ought to be extended as far into the water (but no farther) as those that are now the most out below the bridge; and what I mentioned for Yarmouth side ought likewise to be observed in the repairs of the wharfs on the other side.

As to Yarmouth bridge, if an entire new one should be thought too expensive at present, all its upper works ought at least to be made new; I am sure that an able carpenter can easily place or graft them on the old piles, without the trouble and expense of pulling them up, and driving new ones in their stead.

And as to the last article, viz., the removal of pernicious encroachments, either above or below the said bridge, if any buildings, docks, or advanced wharfs, should be found by a proper and impartial jury, or inquest, deserving to be presented as such, I hope, for the sake of all those who are concerned in the preservation of Yarmouth haven, that either by entreaty or by law they shall be removed.

32. I pass on to what may relate to the preservation of the Braidon, and the navigation through it. As to the Braidon having silted of late years, if it be true, I do not think that it is in the power of any set of men to restore it to its former depth all over, or to give it a greater by any natural method, or by any artifice, without an immense expense, and therefore I advise all persons concerned to rest easy on that head, and the rather so, because I have mentioned already in the first part, that all rivers and lakes do silt up, and deepen alternately after every course of dry and wet years. Moreover, provided that the channel up the Braidon into each of the three rivers be kept free and open for the navigation, the depth of the Braidon everywhere else is not very material to the haven; for all the water in the Braidon that is of any use for scouring the haven, is only that part of it, which having been brought up by the preceding flood, is left there two hours before the end of the succeeding ebb; and for this reason, I must observe, that if, according to my advice, the engine be made use of to deepen that part of the channel up the Braidon, right off Red Coat Point, and thereabouts, where it is rather too shallow for loaded keels, the silt taken up may very easily be disposed of, without carrying it to a further distance than the next shore on either side, taking care, however, for the reason given above, that what is thrown out be not thrown out so near the shore, or in such heaps, as that any part of it does appear at low water, for whatever is under low water mark is of no detriment to the haven, nor any diminution of the back waters.

33. As to the three rivers, the Bure, the Yare, and the Waveney, I have already mentioned that I found them in very good order, excepting their being too much incumbered with rushes and weeds, so that nothing appears to me wanting there than to clear them from the said rushes and weeds, which (in my humble opinion) ought to be done at least twice a year, observing that one of the clearings be always performed a little while before the seeds are ripe, or ready to be shedded; and as the cutting of rushes and weeds is an operation easily performed, and which costs but little, I shall add nothing further.

Gentlemen, I have now gone through all the works and repairs which appear to me the most and soonest necessary to be done, for the preservation and improvement of Yarmouth haven, from the mouth thereof to the town of Yarmouth, and from thence up into the Braidon, and the three rivers; but I have another considerable work to propose, which bids the fairest for clearing the haven's mouth, in time to come, from all shoals and bars, or at least keeping some passages through it always open, and this by employing only such natural means as are in your power, without entering into any dubious (as to success) or expensive works.

The proposition is this,—to reduce the haven into a reasonable breadth, by wharfing it on each side, from the south end of Yarmouth town to the west end of the remains of the old north pier, and from that part of Suffolk shore, which is opposite to the south end of Yarmouth, to the north extremity of the Brush.

The best position for the fronts of these wharfs are at present (in my humble opinion) the very lines of low water mark, all the way on both sides; by taking in no more, the breadth of the haven would still be very commodious, and no difficulty would occur in the execution of the said wharfs, which would be sufficiently strong, if performed either in the same manner as the Brush wharfing or as the wharfings at Yarmouth town quay.

The first advantage resulting from such wharfing is, that by making as many slips, or docks and stairs, in the said wharfs as shall be thought necessary, there would be, in the first place, no occasion for any jetties or causeways, which I have mentioned to be great nuisances, and which might then be entirely taken away; but the greatest advantage that would certainly result from reducing the haven to the lines of the present low water mark, and for which end chiefly I do propose it, is that the duration and velocity of the back waters would thereby be greatly increased, and consequently the shoals in the haven, and perhaps the whole bar, or at least the greatest part of it, would be soon carried into the sea.

Moreover the haven would acquire a good depth of water all the way, and consequently deepen where it wants it most, which is between the town's end and the fort, the haven spreading itself between those two places into several bights of no use to navigation; and whoever will consider the good stream which the back waters have at Yarmouth bridge, and indeed all the way lower to the south end of Yarmouth town, before the haven begins to widen, must be convinced of the truth of what is asserted. I only know of two objections to this proposition, viz.:

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Some persons may imagine that the haven being made narrower, the tides would not flow so freely up into the haven, and consequently that the tides of flood would not rise so high as they do now in the Braidon and the three rivers, nor run so far up into the country, so that instead of an increase of back water, as is proposed, they may fear that there would be even less than at present; but those, who may think so, do not consider that there is no intention by this last proposal, to reduce the breadth of the entrance of the haven between the piers, through which the tides of flood that go up must enter, and will enter as before, nor to lessen the haven at the bridge, through which all that goes up into the Braidon and the three rivers must pass, and will pass then as it does now, and that the reducing the haven, between the town and the fort, to the lines of its low water marks, will still leave it wider all the way than it is at the entrance between the piers, or at the bridge, and therefore the tides will no ways be affected by this reduction; and indeed were it not on account of the great expense of a close piling, and other expensive works, I would have proposed the reducing the breadth of the haven, between the town and the fort, not only to the lines of low water marks, but so much more, as to reduce it all the way to a regular breadth nowhere exceeding the breadth of the river at the south end of the town; but this may be left to some succeeding generations.

The other objection likely to be made is, that the haven is good enough at present, and that the expense of reducing it, as proposed, would amount to very large sums. As to the first part of this objection, I am not of opinion that the haven is good enough, or as good as it might be, but that it might, and ought to be, made deeper and its entrance cleared, which is the chief intent of the proposition; and as to the expense, I have reasons to think it will not be so considerable as to deter the persons concerned from the execution thereof. Moreover the fund for these and all other works and amendments, being a duty or tonnage on various kinds of goods, it is certainly the most fair means that can be thought of to obtain such great benefits as those of improving Yarmouth haven, and keeping its entrance clear; sure I am that all the advantages that would then accrue to the city of Norwich, town of Yarmouth, and all the adjacent countries, would very soon overbalance the tax of a few years

As to the general estimate or particular estimates of all works and repairs which I have proposed, it is hardly possible to be very exact in such a variety of articles; but since I am of opinion that the methods of construction already made use of for the piers, jetties, and wharfings, will be sufficient if performed carefully, precedents cannot be wanting to judge of the reasonableness of all future proposals for those kinds of works and repairs: and as to the filling of the new south pier with stone mortar, since no such work, that I know of, has lately been done in England, it cannot be estimated to a nicety, but I can safely affirm that it will be the cheapest of all those which will fully answer the purpose intended. I think it therefore sufficient to mention in general, that from the several computations I made, and so far as I am able to judge, the whole net amount of the expense of all the said works and repairs, exclusive of all such incidental charges as are unavoidable in the execution of all such public undertakings, will not exceed 22,000*l.*, and will not require above four or five years at most to complete them.

But before I conclude, give me leave, gentlemen, to add a few words of advice as to the execution of whatever works shall be thought necessary to be done hereafter.

Since it is impossible to avoid having some parts of the works performed any other way than by day's work, wherein the greatest impositions and frauds are, or may be committed, I humbly advise to do as little work as possible by day's work; and what shall be found impracticable to be done any other way, or such that no body will offer to do it by contract at a reasonable price, let it be committed under the care of an able and honest surveyor or overseer, who (as well as a comptroller or clerk of the check, if there should be occasion for one) should be chosen by merit, and not by favour; should have authority and latitude enough to make all the people under them do their duty and obey directions, by having it in their power to turn away the common men, and at least to suspend the masters till further orders, in case of their misbehaving; and as those persons should have sufficient allowances, so should they themselves be dismissed and severely punished, if they were found to encourage, or connive at, any fraud.

On the other hand, I recommend, that in all works which I have proposed, as much as can be done ought to be done by contract; in which the prices and times of performance be limited, with a saving clause in each, that any alteration or variation in the designs or execution, from what was at first contracted for, shall not vacate the contracts, &c. Yet I cannot recommend the method of receiving sealed proposals for the works, and taking the lowest of all the proposers, who can find security, preferable to all other considerations, such as superior knowledge, great practice, and a good character; because I know that the proposers endeavour to beat one another down in their prices, and to get into the works offer to perform them at so low rates, that they must either lose by it, or save themselves upon the quantities or qualities, or both, of the materials delivered, and work done.

As to the order of time in which the several new works and repairs, mentioned in this report, ought to be done, I would advise to follow the very same order in which they are set down; that is to say, the first care should be to repair the new south pier, and to make it tight, and the last work should be the new wharfings proposed all the way on both sides of the haven. If these wharfings be resolved upon, the new bank or wall of earth, which I advised to be erected between the Brush and the high lands of the Suffolk coast, will be saved; but if the wharfings are not approved of, or be postponed for many years, the said bank should either be built the first of all, or at least be taken in hand, together with, or soon after the repairs, and the filling up of the new south pier.

Gentlemen, I have now gone through the last part of my report in as few words as the nature of the subject would admit of, and I could not be less explicit in practical matter of so great concern. I have on every head, and through the whole of this report, given you my opinion, fully, fairly and honestly, with the chief reasons I had for being of that opinion; I hope, therefore, that for the sake of my good intentions, you will excuse the freedom of my expressions, and moreover will do me the honour of ranking me among those who are, as,

I am, &c.,

CHARLES LABELYE.

To the Right Worshipful the Mayor, Aldermen, and Common Council of the Corporation of Yarmouth, in the County of Norfolk.

No. 244.

Jessop's Report on Improving the Harbour.

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Report of WILLIAM JESSOP, Esq., *on Improving the Harbour.*

GENTLEMEN, *London, 23rd May,* 1798.

I shall not trouble you with any particular description of the harbour or of the waters issuing through it; Mr. Labelye's report describes the whole very circumstantially.

Mr. Nickalls's, to which is attached a plan of the harbour, describes nearly the state it was in at the time of his survey, and it is now nearly in the same state externally, except some considerable repair of the south pier and the rebuilding of the bridge.

Neither shall I trouble you with any comments on their opinions or on the opinion of Mr. Bream, further than generally to say, that while I can subscribe to some of their propositions, I cannot assent to others.

Taking it as I find it on my view, I have only three objects to which to call your attention,—

First,—The repair or, I may almost say, the renovation of the south pier, with the wharfing continued from it called the Brush.

Secondly,—The deepening of the channel or harbour from the haven up to the town of Yarmouth.

And lastly, to the state of the bar at the entrance of the haven.

On the preservation of the pier and works attached to it depends the existence of the haven for such vessels as now make use of it, and although the money annually expended on its repairs appears to have been laid out in a way that does credit to those under whose management it has been expended, yet its progress towards ruin seems to outstride the steps which are taken to prevent it. And hence it is necessary that some measures should be speedily adopted, to enable its conservators to arrest the mischief, and put it into a substantial state of security.

The rapid decay of the pier is chiefly to be attributed to the destruction of the timbers under water by the worm; and I should have been much inclined to recommend stone in the renovation of the pier, instead of timber, if I had not been satisfied by a strict examination of the present state of it, that the means made use of in defending the timber from their attack, by covering the surface of them with scupper nails, had the desired effect. Under this impression I see no reason for altering the present process, and I do but common justice to the person who has the executive management of the repairs of the pier, in saying that the manner in which he does the work leaves no room for me to recommend any deviation from it.

While I am saying this, I must also observe, that in point of economy, I should recommend the using of fir timber for what they call the split piles instead of oak, because, when guarded by the nails, I think in salt water they are nearly as durable as oak; because they are everywhere guarded from violence by oak fender piles, and because of the enormous price of seven shillings per cubic foot, which from their very great length they perhaps necessarily cost; fir piles may be obtained for much less than half the money.

I must also recommend that, as the work of repair proceeds, the cavity of the pier should be filled with chalk or with large flints, either of which, I am informed, may be put into it at the cost of *4s. 6d.* per ton, and probably by good management and under large contracts, it may be done for less money.

I send herewith a sketch of the pier and haven as it now appears, with such alterations of the form of it as I mean to recommend. If it were to be entirely renewed, I should probably have advised a change both of the form and position.

The angles and recesses in it are said to be convenient to vessels which bring up and moor to it within the haven's mouth, and in this case they can only be considered as necessary evils; if they do good it is well, for the degree of harm resulting from them is not much worth attention.

But in the renewal of the wharfing called the Brush, I must coincide in opinion with those who have recommended, that the angle or turn from the haven to the harbour above should be softened by the projection of the wharfing in an easy curve, something like what is described by the red line from A to B, the effect of which will be to preserve deep water all the way against the Brush, to wear away the opposite point, to admit a freer flow and reflow of the tides, and a more easy passage to the shipping; if the state of the present wharfing of the Brush had been such as to require only a partial repair, the new work needed not to have been extended quite so far, but as the whole wants renewing, little could be saved by curtailing it. I apprehend the cost of this will be less than the repair of the old wharfing, as its length will be less by 220 feet, and much of the expense of the repairing the old work arises from taking out the stone and rubbish from the foundation to enable them to drive the new piles.

It may be objected that the shortening the line of wharfing against the Brush will deprive the shipping of as much room of mooring. It is a pity there should be a necessity for vessels lying at all so near the entrance of the harbour, especially in the curved part of it; and by extending the Brush upward, to gain as much length in the straight part of the harbour as may be lost in the curved part, shipping may moor against it with much less inconvenience to vessels which are passing.

The deepening of the channel from the haven towards the town comes next to be considered. I took the soundings of it at low water of a neap tide from the bridge to the bar, and found the depths as follows :—

	Feet.		Feet.
Under the Draw-bridge . . .	20	Mr. Burness's house	10
50 yards lower	22	Bollard Point	8½
Below Pelgrave's warehouse . .	20	Sir E. Lacon's malthouse . . .	9
Opposite the Townhall . . .	18	Farthing Ferry . .	9
Preston's ship-yard	14	Gorleston mill	9
Wooden ship-yard	20	Johnson's boat-house . . .	9
Dawson's warehouse. . . .	18	Bend above the Brush and pier from 8 to	7½
The Mount Wall	16	Against the Brush and pier from 13 to	15
Ballast Quay	14	And at the Bar	9
Bottom of Oilhouse Wharf. . .	14		

I also measured the breadth of the river in several places, and found, as I expected, that the depths are the least where the width is the greatest; the width at the bridge is 150 feet, at the quay about 260 feet, but near 100 feet is taken from that by the shipping; as the river becomes more expanded below, the depths decrease, and at the bend for some distance above the Brush, where the width is about 360 feet, the depth was only 7½ feet; here I found several vessels aground in the channel.

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The remedy for this defect is very obvious; I would contract the breadth by a low wharfing and embankment on the eastern side of the harbour, beginning at the point C, and extending it upwards at the distance of 250 feet from the low water mark on the opposite or western shore; how far it may be necessary to extend this embankment, I must leave to be determined by those who may best know how much it may be necessary to increase the depth of the harbour, and they will best form a judgment on this subject, when by a partial experiment they may observe the effect of it, and know the expense that will attend it. If this trial answers expectation, the next place for repeating it should be opposite Bollard Point, where the embankment should be on the west side of the harbour, at the distance of 250 feet from the eastern low water mark.

I should make this low wharfing of fir piles, six inches in thickness, driven down to the level of low water; their heads to be spiked to a wale or string piece, which may be land-tied by 1-inch square bars of iron, at the distance of three yards from each other, the vacuity behind the piles to be filled with the matter dredged out of the channel by the machine, which is now used for similar purposes above the top of those piles. I would raise a bank to about the level of high water, and cover the sloping face of it with flints, in the way already practised on the borders of Breydon and other places. The section annexed will better explain it.

By a due extension of the process here recommended, I have no doubt that any vessel that can come over the bar may proceed to Yarmouth Quay, even should the depth over the bar be increased by a future extension of the pier; and, among the benefits to be derived from this improvement, that of taking many vessels out of the way, which from necessity now lie in the haven, is not a small one.

I have now to submit to you a few observations respecting the bar.

Though it is an indisputable fact, that all matter kept in motion by a current will tend to subside as soon as that current is checked by a meeting with expanded or nearly stagnant water, and, consequently, will tend to form a bar, yet it is as true that very little of the bar of Yarmouth Haven is formed of matter brought down by the inland waters, for their motion is too languid to move anything but mud or silt; and the great receptacle of Braydon arrests nearly the whole of it.

The matter forming the bar originates from the steep parts of the coast which are lashed by the waves of the sea; the smaller and lighter particles of which are moved to great distances, and are ultimately deposited in parts where the waters have but little motion, forming gradually vast tracks of flat land called Salt Marshes, while the heavier particles agitated by the undulations of the sea, sometimes in one direction, sometimes in another, subject to the variation of the winds, form the numerous banks and breaches, which from their liability to alter their form and position continually keep awake the attention of mariners.

But much of the uncertainty which arises from the causes above mentioned is corrected by the motion of the currents of the flowing and ebbing tides, which, depending on causes more regular and certain, produce effects more constant and permanent.

Hence the deep channel of Yarmouth Roads is subject to little variation, and the tide flowing through it from the northward exerts its influence so near to the haven, that the bar at its mouth is hardly a ship's length from the end of the south pier, beyond which the depth increases very considerably within a short distance. I am informed that, except for some short intervals, it has preserved this position for six or seven years, and that within this period the channel, called Saint Nicholas's Gat, has very much increased in its width; to what cause this latter alteration, so very advantageous to the entrance of ships into the roads from the south-eastward, is to be imputed, may not be easy to assign; but probably the present favourable state of the bar may be considered as one of its effects. I found the depth on the bar at low water of a neap tide to be nine feet, and am informed that some years ago it was considered as in a good state when there were six or seven feet on it at low water. Part of this improvement has, no doubt, been owing to the extension of the pier, before the very great alteration took place of the widening of the Gat; and, although in what I submit to the Commissioners toward the immediate improvement of the harbour, I do not urge the extension of the pier as a part of it, I cannot help recommending it to their attention, as an object that will promote a further improvement, whenever the circumstances of the country and the revenues of the port may enable them to undertake it.

The principal use of the south pier is to confine and direct the waters ebbing from the harbour, so as to preserve their velocity; the greater the distance out from the general line of the sea coast the pier may be protruded, the more the matter deposited to form a bar becomes subject to the action of the southward and northwardly current of the flowing and ebbing tides in the road, for the velocity of such flowing and ebbing tides increases with the distance from the shore. I have already observed, that the matter forming the bar is not brought down by the rivers. It is, in fact, washed into the harbour's mouth from the beach or point to the north of it, and from thence it is transferred to the bar.

I here beg leave to observe, that supposing the end of the south pier a permanent point, if it were possible to cut away the beach, so as to unite the channel of the road nearer to the land, the effect would be the same as might be expected from an extension of the pier, as, in fact, it would be a relative extension of the pier; admitting this, though the beach could not absolutely be cut away, it at least indicates the impropriety of erecting, or continuing, any work of art, that may tend to the increase of the beach to the north of the haven's mouth. I have, therefore, no hesitation in saying, that the old north pier has a mischievous tendency, and strongly recommending that it should be entirely taken away.

I was informed there was some intention of making a break-water or jetty on the south side of the south pier. I do not think that any benefit to be derived from it will be worth the expense that will attend it.

Having been informed that some years since a raging tide made a breach in the sea banks, about ten miles northward of the harbour, it was supposed that a large quantity of water entering thereby had, by passing down the north river, been beneficial to the harbour by increasing the depth over the bar; and it was suggested, that if, by artificial means, water could again be taken in there from the sea, and an opening permanently maintained, it might be a valuable acquisition: but in viewing the place I found it to be impracticable.

Any increase of inland waters would proportionally benefit the harbour. There has been a time, when Braydon water has been much more extensive; I found that the surface of land embanked from it was six inches below the level of a neap tide, and of course about two feet under spring tides. Many harbours have been ruined by the pernicious practice of embanking marshes from the sea; it is to be hoped that now, when the national importance of harbours is so well known, the conservators of them will watch with zealous attention to prevent any future encroachments.

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Jessop's Report on Improving the Harbour.

I have examined the estimate of the expense of repairing the pier and Brush, and north pier and town jetty, made by the superintendent of the works, and amounting to about 28,000*l.* exclusive of chalk to fill the pier, which will cost about 1000*l.* more. I believe the estimate to be very ample for the several purposes, and cannot say that much can be deducted from it.

The low wharfing or embankment for contracting the river will cost 4*l.* per running yard; when the pier is effectually repaired, and of course if the annual repairs become much reduced, the revenues of the port may be applied to this use; but, at all events, I would recommend that the contraction first mentioned, immediately above the haven, should be done as soon as the Commissioners may be enabled to raise the money for the purpose. I should think about 1000*l.* laid out in this port would effectually deepen, and make permanently good, this worst part of the channel, where vessels so frequently take the ground.

W. JESSOP.

To the Commissioners for repairing, improving, and
maintaining the Harbour of Yarmouth.

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Jessop, on the State of the Harbour.

Correspondence of Mr. JESSOP *relative to the State of the Harbour.*

GENTLEMEN, *London*, 15*th July*, 1799.

As no material alteration has taken place in the general state of the haven since I first surveyed it, I have little to add to my former report; but I think it essential to repeat, what I then considered as the most important feature of it, as comprehending in its object the effectual repair and improvement of the pier and haven, with the most economical expenditure of the income, that some measure should be adopted whereby money may be raised to carry on the work with reasonable expedition and substantial effect; for at the time when I first viewed the haven, and I am sorry to say, also, on my late view of it, the progress of improvement appears hardly to keep pace with the progress of decay, and a too great portion of the income has unavoidably been applied to temporary repairs which ought to have been unnecessary, and which, when the intended improvement has been effected, will become useless.

The most considerable portion of this temporary repair has been in the wide part of the pier, through which it appears that a breach had nearly been made in the late stormy winter, which probably would have been attended with very serious consequences, if the means made use of to stop it had not been resorted to.

I have now to recommend, that when the external work on the south side of this part of the pier shall be completed—a part of which already done, but left insecure by being discontinued, and from the want of chalk behind it, has been damaged and must be taken up again—the materials of the temporary work should be taken up and made use of toward the principal intention; and as in this wide part of the pier it would be useless, and of course extravagant, to fill the whole with chalk, I would only use chalk for about 12 feet in thickness or width behind the split piles, and fill up the middle part with shingle from the beach.

I will also take the liberty of again recommending, for reasons which I have before given, that the old northern jetty should be taken up, and that the materials may be made use of in the new works; the effect which, I hope, will be the result of this operation will be, the washing away of this part of the beach which the jetty has been intended to defend; and, should this effect take place in a future day in a greater degree than I apprehend it will, or then may appear desirable, I should think it better to submit to the necessity of putting it down again more into the land than to let the present one remain.

To the Commissioners for the Pier and Haven of Yarmouth.

SIR, *Yarmouth*, 11*th Feb.*, 1804.

There is now wanting to complete the river side of the pier, from the work which has been done to the end of the pier, 370 feet in length, including the repair round the head of the pier.

It appears that twice within seven days past a strong easterly wind has cut out the gravel as low as the feet of the piles round the end of the pier, and in consequence about 30 feet in length of the split piles have been taken away.

I am of opinion, that, after the feet of the piles have been nearly bared, the cause of their breaking off was the pier being open on the river side, from which the return of the surge acted from them on the inside as a battering ram; and hence I have reason to believe, that when the pier shall be closed on the river side and be filled with chalk or gravel, the failure of the piles round the end will not again happen, even though they should be again laid nearly bare.

But, as a further precaution, when the end of the pier shall be repaired, by replacing the piles and driving them as deep as possible, it will be advisable to watch the effect of any future storm, whenever from time to time it may happen, and, while it may be deep, having some auxiliary split piles of oak in readiness to drive on the outside of the lower wale piece, bolting them well thereto, so that the tops of them may be level with the lower wale piece.

To John Watson, Esq., Town Clerk.

Yarmouth, 7*th Feb.*, 1805.

With the longest continuance of easterly winds that has been remembered in the winter season, no damage has been done to the works until about the 25th of January, when in consequence of a heavy run of the sea from the Gatway, with a depth of 13 feet over the bar of the haven, the feet of the split piling on the north-east corner of the pier were bared, and four of them have been broken off a little above low water. These must be replaced; but as it is hardly practicable to drive split piles deeper than those which have been already driven, I must recommend that round the end of the pier, for about 60 feet in length, piles of whole balk be driven close to each other on the outside of the split piles, the length of them to be from 34 to 40 feet; and to facilitate the driving them to a greater depth, three feet of the foot of them should be of iron, or, in other words, they should have shoes of cast iron a yard in length,

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two inches square near the point, and four inches square at the connection with the piles, to which they will be joined by four straps of bar iron rivetted to the cast iron and spiked to the pile. This will secure the end of the pier almost against a possibility of derangement.

The town jetty is in a very ruinous state; it would be very desirable to give it a temporary repair at the expense of about £300, which would insure its safety for at least ten years; and without something be done, it is every day in danger of demolition.

To the Commissioners for Yarmouth Haven.

Yarmouth, 29*th June*, 1808.

GENTLEMEN,

As the jetty is in so very ruinous a state that very little of it could remain on the repair of it, in estimating the expense of restoring it, I consider it as for a new jetty, and in this case it might be supposed that any other situation might be chosen for it; but as it does not appear that any advantage could be derived from changing its situation, I must recommend that it should be rebuilt upon the old site of it, for though the old timbers may be of no use as part of a new jetty, they will be of considerable use as scaffolding in driving the piles and erection of a new one.

The length of the old jetty was 450 feet, but it has been complained of as being too short; that the landing at it in rough weather at low water has, from the breakers, been attended with damage and danger to the boats and their crews; I would therefore propose that the new one should be extended to 500 feet in length, and as it has been suggested that returns at the head of it, in the form of a T, will give considerable increase of shelter and accommodation to the boats of His Majesty's Navy, and on the presumption that His Majesty's Admiralty will contribute the expense, I have designed it accordingly; but if I should be mistaken in this supposition, I must then submit to you that it should not exceed its former length and dimensions, or rather that those should be curtailed, as the funds necessary to the continuing and maintaining the works of the harbour and pier could not afford so large a diminution, without endangering perhaps the existence of what has been already done, as the Brush or inner part of the harbour is in a very ruinous state, and should be immediately attended to.

From the scarcity and high price of timber, it will appear from the estimate that the cost of the jetty, as designed, will be £4665; if the extension and enlargement is omitted, there may be a saving from this of about £1500.

As the piles should be driven by horses, two-horse engines may be employed, which will probably drive the whole number in about 70 working days. If the work should not be delayed till the short days of winter, it seems very desirable that no time should be lost in the commencement, considering the great probability of frequent resort to it.

As the planking of the platform appears in the late failure to have been lifted by the swell of the sea, I would recommend that every second plank alternately should be fastened by half the number of spikes, or four instead of eight, so that if they should in another storm be lifted, every other plank would be saved by giving room for the water to rise between them, while it would give a great relief to the framing of the jetty.

On examining the new work at the pier, I find the scupper nails too thinly driven, and the worms have found room to penetrate between them; there are about 170 nails in a square foot. As the duration depends on the exclusion of the worm, I think it will be advisable to drive 400 in a square foot; the nails, too, are usually beat too thin at the head, so that many break off in driving; the heads should be a little thicker, but not quite so broad.

To the Commissioners of the Haven and Pier, Yarmouth.

SIR,

I have long been aware that objections might arise to the cutting off the bight where ships now lay out of the way of others passing in and out, but I have looked forward to a time, when by the contraction of the channel above the pier, and by the didelling engine, the channel might be so deepened as to make berths for shipping further up in the harbour. There could be no doubt that the proposed extension of the wharfing would have the effect of cutting away the point, so as to maintain a sufficient width for the passage of ships; but as so many nautical man are of opinion that the present bight of recess is so essentially necessary to the convenience of the haven, I cannot presume to controvert their opinion; and I therefore would submit to the Commissioners that it may be advisable to make a temporary repair of the wharfing in the present bight, until it may appear by the improvement of the channel above that this recess be no longer necessary, for with the exception above-mentioned, I am confident that the execution of the original design will greatly improve the general navigation of the haven.

I am, &c.,

W. JESSOP.

To John Watson, Esqr., Town Clerk.

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Report on the State of the Bar and Haven at Great Yarmouth, Norfolk, by JOHN RENNIE, Esq., *Engineer.*

London, 29*th May*, 1818.

GENTLEMEN,

Various accounts have been given of the early state and condition of the harbour of Yarmouth, and of the changes that have taken place from time to time, not only of its termination in the sea, but also of its bar, and of the effects that have been produced by the different works which have been executed for its preservation and improvement. These accounts, however, are so vague and undefined, that little that is valuable can be gleaned from them, previous to the year 1670; from that period down to the present time a good deal may be gathered from the haven books, although the minutes and observations contained therein are neither very full nor satisfactory: this much, however, may be collected from these accounts, that previous to the confinement of the haven by piers and jetties, the channel was frequently divided into a number of little streams, which changed their direction and number according to the prevalence of the winds and the land freshes. When storms came

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from easterly points, a bar was thrown up across the mouth of the haven, which the land waters, assisted by the ebbing tide, were not able to remove, until assisted by a change of wind; and when it was removed, this lasted only for a short period; thus the fluctuation was so frequent, that no dependence could be had on it.

From the best information I have been able to collect, the entrance of Yarmouth haven was formerly much farther to the north than it now is; and that, by the execution of various works of art, it has been at different times brought further to the south, until it has been arrested by the erection of piers at the place where it now is. These piers, by confining the channel, have enabled the land waters, assisted by the ebbing tide, to act with greater effect, and thereby to force their passage out to sea.

Changes of this sort are by no means uncommon: the harbours of Aberystwith, of Conway, of New Shoreham, and several others, are striking examples of this sort: when these rivers were in their original state without embankments, the tide water flowed over a great extent of land in the interior of the country, and this water, assisted by the fresh water of these rivers, had sufficient power to scour out and preserve their entrances nearly in a straight direction; but as these spaces were diminished, either by the subsidation of alluvial matter, or by embankments, the receptacles for the tide were diminished, and consequently sand banks were lodged at their entrances, and nature made by degrees a receptacle or reservoir to contain a sufficient quantity of tide water, which, with the fresh water, forced an entrance for itself; these, however, were materially affected by the floods or freshes of these rivers, and by the prevalence of winds and storms. This, perhaps, has been better exemplified at Naw Shoreham than in most other places, as the gradual movement of the entrance to the south is much more recent, it having gone many hundred yards within the memory of man, and is at present several miles to the south of its natural course, whereby a channel has been formed, nearly parallel to the shore, of sufficient extent to receive a quantity of tide water adequate to that which has been taken away.

I have entered thus far into the nature of harbours similarly circumstanced as that of Great Yarmouth, for the purpose of showing the advantage that arises from preserving to the utmost extent that the nature of the case will admit, the receptacles into which the tide flows. Here Breydon is the natural and great receptacle for the tide, and the channel, from the haven's mouth to this point, should not only be cleansed and scoured out, but no sharp turns or projections should be allowed that may obstruct the full and free flow of the tide through it into Breydon; nor should Breydon itself be allowed to be diminished by any further embankment, or by the deposition of any rubbish or earth which may diminish its capacity, otherwise than by the natural settlement of alluvial matter, which cannot be prevented. The present extent of Breydon, as far as I can learn, is about 2600 acres; its former extent far exceeded that quantity: but a considerable part of it is very shallow, and not covered with water until after half flood, so that much of the water passes off on the ebbing tide without producing the powerful scour which could be wished; but I fear this cannot be remedied, unless at an expense which the harbour funds could not defray; it must therefore be taken as it is.

When I was at Yarmouth the beginning of last month, I examined the flowing and ebbing tide at the haven's mouth, and at the bridge; the observations were made on the 7th, two days after the change of the moon, from which it appeared, that while the tide rose 4 feet 2½ inches at the haven's mouth, it only rose 1 foot 10¾ inches near the bridge, being a difference of 2 feet 3¾ inches; and that it rose 18 inches at the haven's mouth before it was felt at all near the bridge; that the same evening it ebbed 5 feet 1½ inch at the haven's mouth, and only 2 feet 3 inches near the bridge, being a difference of 2 feet 10¾ inches, namely, 7 inches more than the preceding rise. It therefore became a question with me as important to be known, namely, whether this difference arose wholly from the difference of level between Yarmouth Bridge and the haven's mouth, or whether it was partly owing to this, or partly owing to the tide being a little before high water on a higher level at the haven's mouth than at the bridge. If this latter proved to be great, it was then natural to suppose it arose partly from obstruction in the channel. These, and other questions, led to the employment of a surveyor capable of taking a correct survey of the haven, and of ascertaining the leading facts connected with it; and for this purpose, Mr. Hamilton Fulton was employed, and from his survey several important facts have been ascertained.

It appears, from a longitudinal section of the haven made by Mr. Fulton, that in low ebbs, at the pier heads, the surface of the water at Yarmouth Bridge is about 3 feet 9 inches higher than at the pier head; that of this fall, there is 11 inches between the bridge and the Naval Store-House, a distance of about 1400 yards; that from this point to the upper end of the turn, at the low brush, a distance of about 2900 yards, is a fall of 1 foot 10 inches; and from thence to the south pier head, a length of about 470 yards, there is a fall of 1 foot; so that the fall is pretty regular between the bridge and the turn at the low brush, but from thence to the pier head it is nearly four times as great.

In the spring tide, measured while I was at Yarmouth, the difference of rise at the pier head and near the bridge was only 2 feet 10¾ inches, as before stated; whereas the fall at low water, by Mr. Fulton's levels, was 3 feet 9 inches, so that, had the rise at the pier head been only 5 feet 1½ inch, as in my case, there would still have been a fall between the bridge and the pier head at high water of 10¼ inches; but at the time these observations were made the river was somewhat flooded, and therefore the low water was not so low as when Mr. Fulton took his levels, and perhaps a part might arise from the tides not ebbing out so much; but the rise of the spring tide, when Mr Fulton made his section, was at the head of the high brush, at the new wharf, 5 feet 6 inches, and at the bridge, 2 feet 1 inch, so that in this length there was a difference of 3 feet 5 inches (the sea was so much agitated that he could not take the rise at the pier head); and if to this is added a fall of 1 foot to the harbour's mouth, as before stated, the whole difference would be 4 feet 5 inches; but as the fall at low water is only 3 feet 9 inches, it appears that the tide in this particular case, a short time before high water, was 8 inches higher at the harbour's mouth than at Yarmouth Bridge, a difference not so great as I expected it would be; but the tides are so affected by winds at Yarmouth, that no certain criterion can be formed from a few trials, to come to any thing like a correct conclusion: the observations on the tides should be continued for several months.

Seeing that the conclusions which could be drawn from the ebbing and flowing of the tides was not so satisfactory as I wished, I directed Mr. Fulton to take a regular set of sections of the haven at high and at low water, between Yarmouth Bridge and the pier head, the result of which has proved much more satisfactory. It appears from these sections, that the area of the river at low water was at the bridge 2081 feet, at the first section below it 2034, but at the second section below

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it the area was 2739, and this continues with very little variation as far as the 15th section, just below the Naval Store-House, when it suddenly diminishes to 2052; this again continues with little variation until the 56th section, where it is exactly the same at the 57th section, which is at the upper end of the pier; and a little below the Hope and Anchor public-house it drops down to 1612, and decreases to the pier head, which is 1300. The average section of the river, between the bridge and number 15, by the Naval Store-House, is 2650; and between the Naval Store-House and number 57, near the Hope and Anchor, is 1952; and from thence to the harbour's mouth 1333; and the depths in the respective parts of the channel are nearly inversely as their widths. At high water, however, of an ordinary tide, the average area of the section of the river, from Yarmouth Bridge to number 15, is 3279; but from number 57 to the mouth of the harbour it is 2425, namely, about one-fourth less than the sections upwards; this diminution at the haven's mouth is not to be wondered at, as the fall in this length is nearly four times as great as it is upwards, and consequently the water moves with a much greater velocity.

From the facts I have stated, it is quite plain, that to obtain a regular depth in the haven between the high brush, or interior part of the pier, the width of the channel should be reduced; and in order that the flowing tides may meet with as little obstruction as possible, all projections and irregular windings should be cut off; and whenever a new bridge is required, the water-way should be enlarged, and the channel scoured out and widened between thence and Brayden, in order that the tide may flow into this receptacle as freely as the nature of the case will admit; for the more water that flows into Breydon each tide, the more there will be to return, and consequently the better the haven will be.

To state my opinion correctly on the general width to which the channel should be reduced would require my spending some time at Yarmouth; but as a general opinion, I think the width of the channel from Brayden to the bridge should not be less than 200 feet; but as the ships lay below the bridge, it ought to be increased in width. At section number 4, it should continue as it now is, at about 240 feet; and from thence to the Naval Store-House, at number 15, there should be a gradual increase to 250 feet, and from this place to the head of the new wharfing at the low brush, to about 270 or 280 feet. The expense of contracting the channel in this way would not be great: the commissioners of the turnpike roads have set a very good example on the west side, and if a similar plan was to be followed up by laying the stones or flints in the line to be marked out for the boundary of the channel, and taking care to give them a much flatter slope, the current, by being confined, would generally deepen the channel of itself; the foot of this embankment of stones should be secured by piles, as the late Mr. Jessop has recommended; there are, however, some places, which, I fear, are too strong and hard for the current to move; these places might be deepened by a machine worked by a steam engine, and the stuff taken up might be deposited behind the embankment of stone, which would strengthen and support it; by proceeding in the work gradually, the channel between Brayden and the low brush would be in a few years brought into the best state of which, in my opinion, it is capable.

Having thus generally given my opinion what is best to be done with the interior harbour, the next, and by far the most important, is that of the entrance, and the keeping down of the bar. In the former case the principles are fixed, and in giving an opinion it is done with confidence that what is advised will be attended by the expected success; but in the latter, there are so many circumstances over which works of art can have little or no controul, that even the principles, though just in themselves, are so affected by storms and by the change of banks and channels to sea-ward, that what in one case is perfectly well calculated to effect the object in view, is entirely changed, when a change of banks or currents without the harbour's mouth gives a different direction to the currents, or exposes the entrance of the harbour to a swell of sea which had not been foreseen.

By the concurring testimony of the pilots and others examined by me, it is proved that the roadstead is much shallower than it formerly was; that St. Nicholas' gatway is become wider, and that the depth of water has diminished in proportion as the width has increased; that in the year 1798, the gatway was more to the northward than the present; and that some years previous to 1798, there were from 10 to 11 fathoms of water in it, where there are now only from 5 to 6 fathoms; the old or northern gatway was about two miles wide, but a new gatway is opened farther south, leaving a bank between them; and I was told that, taking both gatways, the channel or opening is about five miles wide, though what may be called the navigable channel is not above a mile and a half wide. This enlargement of the gatway or channel has no doubt arisen from a change of current, occasioned by other banks having been formed more to the northward, and this is strongly corroborated by the south end of St. Nicholas' bank and that of the Cross bank being much more steep than the north end of Corton bank; by the widening of St Nicholas' gat the entrance to Yarmouth harbour is more exposed than it formerly was, and by the shallowing of the roadstead the bar must naturally become higher.

It is therefore erroneous to conclude that the bar has increased from the extension of the south pier 200 feet, as recommended by the late Mr. Jessop, or the shutting it up by split piles, in place of leaving it open as it formerly was. The changes in the roadstead and on the gatways are sufficient to have caused the increase of the bar, without attributing any part of it to the pier; nor can the pier have any sensible effect in occasioning a diminution of water in the roadstead, or in opening a new channel through St. Nicholas' gat. In further confirmation of what I have said, Mr. Rivet, a pilot at Yarmouth, and a very sensible, intelligent man, says, that about 30 years ago the bar was much worse than it now is; that he has often known vessels, drawing from 8 to 9 feet of water, laid fast on it for 8 or 9 days together; and that there were only then from 8 to 9 feet of water on the bar where there are now from 10 to 11 feet, thus averaging 2 feet deeper than at the former period; and when the pier was much shorter, and the work was open, the roadstead was deeper as well as St. Nicholas' gatway.

The tide of flood sets in from the north, its direction is about south by east half east, and rate about 4 knots per hour; the ebb sets to the north by west half west, and its rate is about 4½ knots per hour; consequently it scours the south end of St. Nicholas' sand and the Cross sand more powerfully than the north end of Corton sand, and this again is assisted by the strong current of tide that ebbs through the channel between Corton bank and the main land. By the entrance of the ebb through St. Nicholas' gat more to the southward than it formerly was, this ebb current, together with that coming along shore, acts strongly on the south pier of Yarmouth harbour and scours away the sand, so that, to the south of this pier, I was told there are now six fathoms at low water, and the sea has encroached very much on the shore south of the pier; unless therefore some measures are taken to

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counteract this effect, it is not improbable that, at no distant period, it will make a breach west of the Anchor and Hope into the bend of the haven at the high brush

Had the pier not been extended and left open, I am inclined to believe that, from the direction of these currents, the entrance to the harbour would have been worse than it now is; but by the extension of the pier, and closing it up with split piles, the ebb current has been made to act with more force on the bar, and therefore, considering the change that has taken place in the roads and in the gatway, it appears to me that the bar is lower than what I should have expected.

With regard to a north pier, shut up with split piles, I am of opinion that, in place of improving the entrance to the harbour and lowering the bar, it would be attended with the opposite effect. I believe it is allowed by every one who has considered the subject, that the setting or flowing tide has more effect in occasioning the bar than that of the ebb-tide, for when the current sets in from the north, the sand in the channel along the shore is agitated and put in motion, and by the indraught of tide up the haven and through the gatway, there is a division in the current, at which division a settlement takes place which forms the bar; that in easterly and south-easterly winds, this settlement of sand and gravel is greater than with any other winds. If they blow strong the bar is raised higher, but it is carried nearer the pier head, and consequently the water from the haven cuts through it, and in a short time makes a tolerably good entrance; but if these winds are moderate and of long duration, the bar becomes wider, and then the water from the haven is not sufficiently powerful to force its way in one channel through it, but divides into several channels, each of which is shallow. When I was at Yarmouth last month, a shingle bank lay about north-east from the pier head, and divided the water from the haven into two channels; this bank was about a foot above the level of low water, so that at high water there was not much above 4 feet on it; the water on the bar itself, which lies about 50 or 60 yards without the pier, was about 5 feet; so that with a 5 feet flow there were 10 feet on it. If a north pier were to be built and closed with split piles, no doubt the whole of the water from the haven would be united in one stream, and its effects on the bar would be greater. Ships coming into the harbour would have the benefit of putting out a hawser and warping into the harbour, provided there was a sufficient depth of water; but this I fear would not be the case, because the north pier would stop the sand coming from the north with the flowing tide, and having no back-water to scour it away, would lodge behind it, and form dry land more to seaward, so that the shore north of the haven's mouth would become more extended than it now is; and as the tide would be turned off by this pier, a part of this sand and gravel over and above what it could stop would lodge on the bar; thus, instead of diminishing the bar in size, it would increase to a greater breadth, which the water from the haven would not be able to move. Other evils would attend a north pier, namely, that of preventing the flowing tide from entering the haven so freely as it now does, and consequently there would be a less rise of tide in it, and vessels making for the harbour, with the flood, would be cast off by the current, and carried past the mouth of the harbour behind the south pier, which, indeed, happens sometimes in its present state, notwithstanding the south pier lies open to receive it, and turns the current up the haven. On the whole, therefore, I am decidedly of opinion, that a north pier, shut up with split piles, would prove highly injurious to the harbour. Something however is wanted, not only to confine the current coming from the haven to one channel, but also to assist ships in getting into the harbour, and this I would propose to be done in the following manner; viz., to make a low pier or jetty of split piles, whose head should not be higher than the level of quarter flood, but perhaps a little lower will answer the purpose; on this jetty a certain number of dolphins should be placed, the height of which should not be less than 4 feet above the highest spring tides; on the heads of these dolphins, a scaffolding of strong planks, supported by cills, well braced and framed, should be laid, so that they would form a complete platform, the same as if it were a regular pier. On the exterior end or head of this platform, and, indeed, on each of the dolphins, if necessary, proper capsterns might be placed to assist vessels in getting into the haven. By an open jetty or pier of this sort. very little interruption would be given to the flood tide; and what interruption it did give, would in a great measure, be compensated by the current from the haven being kept in one channel during the last quarter of ebb and first quarter of flood, by which such gravel banks as I have already described would be prevented from rising to the extent they now do; vessels entering the harbour would have the benefit of the indraught of tide, nearly to the extent they now have; and by the capsterns on this north jetty, they would have all the advantage which a north pier could give in making fast their hawsers to it, and being warped into the harbour. The expense of this work would be much less than a pier shut up by split piles. It would possess all the advantages with few of its defects, and it may be raised or lowered a little at a moderate expense, should it be found advisable on trial to do so.

I have not laid down this open jetty on the plan, because its direction is a point which will require much consideration. If the principle is approved by the commissioners, detailed drawings of it shall be made out, with an estimate of the probable expense, and when these are done I will repair to Yarmouth, and in conjunction with the haven-master, and other skilful nautical people, settle on the direction most suitable to the situation; this I could not well do when at Yarmouth, partly on account of the badness of the weather, and partly on account of not having fully made up my mind on the subject.

The south pier is in a decayed state in several parts, but the works of repair are going on. The filling of the interior with chalk and flints seems, however, to be at a stand; this I think should not be neglected, as in proportion as the timber work decays it will become weaker; and unless weight is given to it by stone or chalk, it will be less able to resist the effects of storms.

The low brush is now repairing in a substantial manner; but the work is not laid out in the line the late Mr. Jessop has recommended, which line seems to me to be laid out with judgment, as well as his general description of the mode of contracting the channel between the entrance and Yarmouth.

I have, &c.,

JOHN RENNIE.

To the Commissioners for repairing, improving, and maintaining the Harbour of Great Yarmouth.

No. 247.
Walker's First Report on the Bar and Haven at Great Yarmouth.

No. 247.

First Report on the State of the Bar and Haven at Great Yarmouth, by J. Walker, Esq., C.E.

Limehouse, London, 27th August, 1825.

Sir,

In compliance with your letter of the 8th ultimo, communicating to me "the request of the Commissioners of the Haven and Pier of Great Yarmouth, that I should attend at that place, and advise on the best way of removing a curvature in the river, lying between the town and the sea, and generally on the improvement of the harbour," I attended at Yarmouth on the 8th of August, and was informed by the Mayor, that the object to which my attention was wished to be particularly directed was the removal of the curve in the river, formed by the Ballard-point. He also stated to me, that, as I was at the place, it would be desirable that I should view the haven, the waters connected with it, and the bar, and suggest generally such things as might appear to me worthy of attention, with a view to their improvement.

The improvement at Ballard-point being thus the leading object of my survey, I have while at Yarmouth and since treated it as such, and have prepared a plan for the improvement: to which I beg to refer you, explanatory of what I would propose for the alteration.

The distance saved by the substitution of the straight line is not so great, as, in my opinion, to have justified the expense of the work; but the alteration is considered, by those whose experience enables them to be the best judges, advisable for the following more important reason:—To enable a vessel to get from the pool and over the bar without losing a tide, it is necessary that she leaves the former some time before high water, and come down to the haven's mouth against the flood tide, so as to get over the bar soon after high water. Now, in this case, unless the wind be fair, and so strong as to give the vessel way enough to get round the point, she is liable to be carried by the opposing force of the tide into the bay on the west side of the river, opposite to the Ballard-point, the strength of the tide being in that direction; delay or damage is stated to be the frequent consequence. This evil will be avoided by the proposed improvement, and will be the most important effect of it. But besides this, the set of the current in the river will be improved, and the low-water fall, which is stated by Mr. Fulton's survey to be three feet nine inches from the entrance of the haven to the bridge, will be somewhat reduced by the water (above the point where the improvement is proposed) being lowered; the tide also, above the point (which, owing to the narrow inlet or mouth, is prevented reaching to the same level in the pool as at sea), will rise a very litle higher than it now does. The facilitating the passage of ships down the river is, however, as I have already stated, the strongest argument for the improvement, and the only one which renders so great an alteration worthy of the expense; as the other useful objects I have referred to may be affected in some measure by rounding off the very sharp point of the Ballard, filling up the bay on the west side, and regulating the section of the river, as I have afterwards proposed being done, between the Ballard-point and the Brush. *(See the dotted lines upon the plan.)*

The accompanying cross section for the New Cut corresponds nearly in width and form with the present river, where the New Cut joins it; or rather with what I think the present river should be made to be. The width between the points of low water is 260 feet; the depth at low water 10 feet 6 inches, for a width of 70 feet; at the low water point, a low close piling, or piles with wattled or brush or faggot work between, is proposed on each side, from two to three feet high; and from the top of this the ground is laid with a slope, until it meets high water level, where it is terminated by a bank or wall, to prevent the overflow of extreme tides. The object of the dwarf piling or brush-work is to regulate and preserve the low-water section, and to increase the scour during the last half of the ebb, when the effect upon the channel is the greatest; and the slope from the head of the piling is made to prevent the expense of a higher piling, and to diminish in as small a degree as possible the extent of the surface [illegible]l with the tide-water, and which forms the back-water for the bar. The contraction of the width of the river has been before recommended by Mr. Jessop and Mr. Rennie in their reports, but their plans appear to have gone to a contraction up to high-water mark.

The excavated soil from the New Cut is proposed to be applied partly to raise the ground on the east side, so as to prevent in future the drifting of the sand into the river, this being besides the most convenient place for laying it; and partly to fill up the present course of the river. The section shows how this will be left when finished.

From a general measurement of the work, I think the expense of the alterations, exclusive of the piling, will be about five thousand pounds: but a more detailed measurement will be necessary to enable me to form an exact estimate; or if you resolve to have the work contracted for at a sum, which will probably be the most certain and cheapest way, the tenders will determine the cost; and in this case, I should recommend an application to a few respectable tradesmen, who would be likely to do the work well, and give you little trouble.

Thus much for the Ballard-point.

The first subject of my general observation is in some measure connected with it; I refer to the improvement in the navigation of the river generally, between its mouth and the town or pool.

One of the causes of the inequality of depth will be removed by the proposed improvement at the Ballard; but the shallowest water at present is rather below that point. This is caused partly by the inequality of width, and by the water at the time of the greatest current being allowed to spread itself over the very flat slope of the shore above low-water; and partly by the set which the river has into the elbow of the brush, which adds to the quickness of the turn in the direction of the water, and consequently forms a check to its velocity before it reaches the turn. The former of these evils will be removed in a great degree, by forming the river into a determined and fair line, both as regards direction and width; which I propose being done by continuing the dwarf piling, or piles and faggots, I have recommended for the New Cut at the Ballard, along both sides of the river, and by giving the part near the brush a more easterly direction. In order to make my ideas the better understood upon this subject, I have had a copy made of part of Mr. Fulton's plan of the river, upon which I have marked the proposed improvement, to which I beg to refer you. I have also extended one of Mr. Fulton's cross sections upon a larger scale, and have shown upon it the river, as I think it should be. In the plan and section, the river in its present state is coloured blue, the improved line and section are red. The piling being first done, I would propose the section to be formed to what I have suggested by the dredging-machine, after which I think it will support its depth, as the area of the low-water section is not greater than the present area; the additional depth being obtained by making

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the lines uniform, and bringing the deep water together so as to be useful for navigation. You will observe by the section, that I have supposed a depth of 10 feet 6 inches at low water, for a width of 70 feet the whole length.

After the river is contracted in this way, every encroachment within the line of piling should be carefully prevented, as tending directly to renew the evil arising from the present inequality of section.*

The very quick turn at the brush may I think be eased, and the wharfing strengthened, by reducing the unnecessary depth of water opposite the brush. This can be done by bringing the whole space which is under a fixed depth (as say 13 or 14 feet at low water) up to this level, by means of large chalk, flint, ragstone, or such other material as the action of the water cannot displace. The water will then gain in width upon the loose sand what it will be unable to do in depth; and by this, and the change of direction above the brush, to which I have referred, I hope the form of the curve may be brought to approach to the red lines drawn upon the plans.

When so near the bar, I beg to say a few words in regard to it.

Of the cause of the bar there is no doubt. During heavy winds the sea-water near the shore is mixed with a quantity of sand or shingles, which is kept in motion while the tide is running strong at sea, parallel to the shore; but when its velocity is checked by the indraught of the river, it is deposited upon the whole space between the river's mouth and the point where the indraught is felt; and would soon entirely choke up the mouth of the harbour, were it not for the return of the ebb current down the river, which acts as a back-water, and, to a certain extent, removes the matter which has been collected by the flood; as this ebbing water spreads and meets the current of the ebb tide at sea, which is running northward, its force decreases, and being unable longer to support the matter, which it has brought down with it, or to clear away what has been deposited during the flood, the bar is formed; which would in its turn rise so as to completely block the harbour but for the cross current, and particularly the strength of the current of tide at sea, which prevents an accumulation above a certain level. Anything, therefore, that tends to increase the power of this back-water, to give it a proper direction, or to keep its force collected and undiminished until it reaches deep water, at a distance from the shore, and where the force of the tide at sea is such as to maintain a sufficient depth of water, helps to reduce the bar. The south pier is agreed by all practical men and engineers to have had a good effect: their opinion of a north pier is much more doubtful. My own opinion of it is favourable, upon the principles I have mentioned. I think that, so far as it goes, it protects the current out of the haven from the cross action of the tide at sea, and tends to preserve it in the proper direction. It is upon the same principle, that the bank of sand (called the North), which extends eastward from the end of the north pier head,† can have an effect upon the bar. It is a general saying, that "a good north brings a good bar." When I was at Yarmouth, this bank extended about four hundred yards from the pier-head; was bare at low water for half the length, and at the end of the four hundred yards, had only two feet of water upon it: then the depth of water upon the bar was six feet and a half to seven feet at low water, which was stated to be four feet more than there sometimes is. This has been so for the last eight months, when the North was formed by a strong north-west wind. As a good bar is thus the general accompaniment of a high north, is it a consequence of it? I think it is. The North, or bank, acts as an obstacle to the free current of the ebb tide passing along shore to northward: the force of the water ebbing from the haven thus meets with the less interruption, and arrives at the point where the bar is formed with greater force than when it has to encounter a strong cross tide immediately it gets clear of the pier head; thus the North acts for its height as a pier would do. The pilots, without accounting for it, feel assured, that so long as they have the north as it is, they will have nearly the same water upon the bar, and dread the effects of a south-east wind, which will drive away the North, and spoil the bar. If, then, this natural low-water pier is useful, one is naturally disposed to conclude, that it would be desirable to render it permanent; and this might probably be done by means of a groyne, formed at first to a short length and height, and done in the least expensive manner, as an experiment, until its effects were ascertained. For the reasons I have stated, I am inclined to think that very beneficial results would be felt from it: but in a matter where the opinion of eminent men has been different, I am disposed to recommend caution; the experiment is surely worth the trial.

The narrow embankment between the Anchor and Hope and the high ground has, it appears, been considerably strengthened under the directions of Mr. Crane, your resident engineer, but it is still weak. I would recommend Mr. Crane's operations to be continued, and a groyne or low piling to be formed in the angle behind the Anchor and Hope, to protect that part, and encourage a deposit of gravel behind it.‡

The Mayor, Mr. Watson, and Mr. Crane, were so good as to accompany me up Braydon, and thence several miles up the Yare. So far as we went up the Yare, the depth of water was very considerable, and the river well adapted for navigation; but towards the upper end of Braydon, and upon the Burgh flats, the depth did not, in some places, exceed four feet at low water; and the craft, which now navigate have from this cause, and from the deepest water not being distinctly marked out, some difficulty to encounter.

There seemed also some doubt as to the line which is piled not being in the best direction. So important a point should be attended to, and when ascertained, a good dredging-engine would soon clear a passage for vessels of greater depth than the present. The mud raised should be laid in the recesses. I noticed one particularly, near the head of Braydon, opposite the shallowest part, which I observed might be in some measure the cause of the evil. If the barges, into which the stuff from the engine is loaded, had false bottoms, as at Hull and other places, much of the expense of the unloading would be saved, when the depth of water, where the mud is to be deposited, is sufficient for floating them. An addition of a few feet to the navigable depth of Braydon would be a most important improvement, and when obtained, may probably be kept up at a very trifling expense indeed, particularly if steam tug-vessels between Yarmouth and Norwich come into use, as they must soon do; their paddles, and the quick motion of their retinue of loaded vessels, tend much to prevent mud from settling.

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* I am aware that the expense of the dwarf piling, done in the cheapest way, will be considerable, and that this may be an objection to the improvement to the full extent; but the deepening only of the river for 70 feet in width, to the 10 feet or 10 feet 6 inches standard, would be a matter of small cost. Some of the heaviest matters might be deposited in the holes, near the point of low water; the river would thus be improved, and would probably preserve its section for a long time.

† See the dotted lines upon the plan.

‡ The sea is evidently gaining upon this piling; and unless it be effectually prevented, will be likely to carry it away during the approaching winter: no time should be lost in preventing such an evil.

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I was a good deal surprised to find that steam is not in use for the purpose of dragging. If the commissioners are interested in the dispatch of commerce between Yarmouth and the interior, they would do well to encourage it, both as to the means of dispatch, and of cleansing the rivers. If one were set to work, the example would soon be followed. Almost every barge with goods between Greenock and Glasgow, upon the Clyde, is now tugged up by steam. The situations are somewhat similar to those of Yarmouth and Norwich.

After the advice given, and repeated by former engineers, of the necessity of preventing the embankment of any part of Braydon, it cannot be necessary for me to add my voice, as almost the existence of Yarmouth and its harbour depends upon it. If you have not, you ought to have land marks all round, and a plan of the whole, to detect any encroachment. The whole should be occasionally perambulated in proper form, upon certain days, and the smallest inroad noticed.

Your present dredging-engine is worked by two horses—a power very unequal to any important work; and such is the spirit for improvement that is abroad, that you will be almost constrained to be led by it, so as at the least to bring into action all the capabilities of the present line of navigation. I would recommend your having a dredging-engine worked by steam, of not less than six horses' power: the nature and magnitude of the navigation and trade render this an almost necessary machine.

I fear that, to widen the passage between the harbour and Braydon, under and near the bridge, would be a work of too great an expense to recommend at present; but for this, the measure would be extremely desirable, and should be kept in view as a work to be done when you have the means of effecting it. But although this obstacle presents itself to facilitating the passage of the water under the bridge, I could see none to prevent the facilitating the passage of carriages over it. This may be done by lowering the meeting of the two halves of the draw-bridge, still leaving rise enough for giving it sufficient stiffness and strength.* I explained my ideas to Mr. Crane, who agreed with me that the improvement is practicable at an easy expense.

I have thus put you in possession of the ideas as they occurred to me on the different points; more detailed information, and a more particular survey than I could make, during the few days I was at Yarmouth, will be required to justify me in decidedly recommending some of the measures which I have referred to I have thrown them out for consideration, and ought, perhaps, rather to have submitted them in the shape of queries than as opinions.

I have been favoured with a copy of Mr. Telford's report on the subject of forming a communication to Norwich for sea-going vessels, by a cut, to avoid Braydon, or by a new opening into the sea at Lowestoft, upon which it would be presumption in me to venture an opinion, as I have not surveyed either of the lines, further than by adducing what is therein stated, in proof of the necessity of activity on your part; for if, by improving your harbour and Braydon, you give a capability equal to what is proposed by the new cuts (and I do not see the great difficulty of doing this), the proper objects of the projectors of these new lines will, I conceive, be effected, and probably the true interest of Yarmouth promoted.

The rate and mode of travelling by water is improving, as that by land has done, in which the long established coach-owners have found the necessity of increased speed and convenience, to prevent the interference of active opponents.

I am, &c.,
J. WALKER.

To Samuel Tolver, Esq., Town Clerk.

No. 248.
Walker's Second Report on the Bar and Haven at Great Yarmouth.

No. 248.

Second Report on the state of the Bar and Haven, by JAMES WALKER, Esq., C.E.

Limehouse, London, 1st *July,* 1826.

SIR,

Since the end of last Session of Parliament, my attention has been again particularly directed to the best means of improving the harbour of Yarmouth, in consequence of the instructions I had from the Commissioners who were in London when the Norwich and Lowestoft Navigation Bill was before the House of Commons, and the more particular order of the meeting of the 13th of June, when I attended and stated my opinion of the measures I thought desirable for the improvement of the harbour, similar in substance to the following report, and when in consequence materials for the works were ordered to be advertised for.

Certain surveys and levels being necessary, to enable me to form an accurate opinion of the present state of the entrance, the bar, the backwater, &c., with a view to further improvements, I have, with the assistance of Mr. Timperley, proceeded with these, and with the necessary plans and estimates of the proposed works.

Upon the plan of the entrance, which accompanies this report, the soundings upon and near the bar have been taken with great care. They will be useful, not only to enable you to judge of the present defects, and the necessity for remedying them, but as a record by which you may at all times compare the present with future surveys, and thus be enabled to judge accurately as to the effects of any works which may in future be executed with the view to improvement.

Of the points to which my attention has principally been directed, the most important is "The improvement of the Bar."

In my report, of the 25th August, 1825, I stated my opinion of the cause of the bar, which is the same as has been held by the eminent engineers who have before reported upon it.

I also endeavoured to show, why a good bar is the accompaniment of a high north, that is, of a high bank on the north side of the entrance, outside the north pier; and I deduced thence the conclusion, that a permanent north would produce a permanently good bar.

As the measure I now mean to recommend is founded upon the reasoning in that report, I think it proper to bring it to the recollection of the Commisssioners by the following extract:—

"Of the cause of the bar there is no doubt. During heavy winds the sea-water near the shore is mixed with a quantity of sand or shingles, which is kept in motion while the tide is running strong at sea, parallel to the shore; but when its velocity is checked by the indraught of the river, it is depo-

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* A still cheaper mode would be, by raising the roadway of the draw-bridge at the ends, and accommodating the approaches.

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sited upon the whole space between the river's mouth and the point where the indraught is felt; and would soon entirely choke up the mouth of the harbour, were it not for the return of the ebb current down the river, which acts as a back-water, and, to a certain extent, removes the matter which has been collected by the flood; as this ebbing water spreads and meets the current of the ebb-tide at sea, which is running northward, its force decreases, and being unable longer to support the matter which it has brought down with it, or to clear away what has been deposited during the flood, the bar is formed; which would in its turn rise so as to completely block the harbour, but for the cross current, and particularly the strength of current of tide at sea, which prevents an accumulation above a certain level. Anything, therefore, that tends to increase the power of this back-water, to give it a proper direction, or to keep its force collected and undiminished until it reaches deep water at the distance from the shore, and where the force of the tide at sea is such as to maintain a sufficient depth of water, helps to reduce the bar. The south pier is agreed by all practical men and engineers to have had a good effect: their opinion of a north pier is much more doubtful. My own opinion of it is favourable, upon the principles I have mentioned. I think that, so far as it goes, it protects the current out of the haven, from the cross action of the tide at sea, and tends to preserve it in the proper direction. It is upon the same principle, that the bank of sand (called the North), which extends eastward from the end of the north pier head, can have an effect upon the bar. It is a general saying, that 'a good north brings a good bar. When I was at Yarmouth, this bank extended about four hundred yards from the pier head; was bare at low water for half the length, and at the end of the four hundred yards had only two feet of water upon it; then the depth of water upon the bar was six feet and a-half to seven feet at low water, which was stated to be more than there sometimes is. This has been so for the last eight months, when the North was formed by a strong north-west wind. As a good bar is thus the general accompaniment of a high north, is it a consequence of it? I think it is. The North, or bank, acts as an obstacle to the free current of the ebb-tide passing along shore to northward: the force of the water ebbing from the haven thus meets with the less interruption, and arrives at the point where the bar is formed with greater force than when it has to encounter a strong cross-tide immediately it gets clear of the pier head; thus the north acts for its height as a pier would do. The pilots, without accounting for it, feel assured that so long as they have the North as it is, they will have nearly the same water upon the bar, and dread the effects of a south-east wind, which will drive away the North, and spoil the bar. If, then, this natural low-water pier is useful, one is naturally disposed to conclude, that it would be desirable to render it permanent; and this might probably be done by means of a groyne, formed at first to a short length and height, and done in the least expensive manner, as an experiment, until its effects were ascertained. For the reasons I have stated, I am inclined to think that very beneficial results would be felt from it: but in a matter where the opinion of eminent men has been different, I am disposed to recommend caution; the experiment is surely worth the trial."

I advanced, at the time, the above opinion of the effect of extending the north pier with some doubt, both because the reasoning upon which it was founded was in some degree new, and because I found that engineers, for whose name I entertain respect, had been more than doubtful as to the propriety of the measure.

I refer principally to Mr. Rennie's printed report of 18th May, 1818. Since that time, however, an experiment has been made, partly under his direction, by the erection of the present north pier, which is closed to three-quarter's flood. This has had the effect of stopping the sand coming from the northward, and thus of extending the shore or dry land north of the haven's mouth more to seaward, and of turning off the tide of flood from acting on the bar. These are the effects which Mr. Rennie anticipated; but they had proved beneficial, rather than, as he feared, injurious in their effects.

The extension has also been accompanied with the other useful effects, which he mentions, so that I feel assured that the experiment which has been made, and which Mr. R. recommended not being carried higher than quarter flood, has, since it was closed to three-quarter's flood, been very useful, and would be still more so, if closed to above high-water so as entirely to stop the sand getting through the piling into the haven's mouth; for the accumulation of sand north of the pier is already such as to prevent any current of flood-tide, that can be at all useful, passing through the open piling of the pier, while the passage of the sand is evidently hurtful.

Previous to the erection of the present north pier, when, by a continuance of high easterly winds, the bar in front of the entrance was raised so as sometimes to be dry at low water, the water out of the haven, having liberty to spread in all directions, found less difficulty, with the assistance of ebb-tide, in forcing its passage through the bank on the north-east and south-east, than through the front; and thus the deepest water for ships was for a time in those directions, until, by the assistance of the wind from the shore, the bank in front of the entrance was carried off, and the haven's water resumed its straight course.

This division of the current, and the uncertainty of the passage, which was every way injurious, has been remedied by the north pier; for, since its erection, the depth upon the bar appears to have increased, and what is of equal importance, it has been uniform and steady, arising, without doubt, from the north pier and the north sand outside of it (which is one of the effects of the north pier) confining the back-water into one channel.

The first improvement, therefore, which I would propose is to close the present north pier above the level of high water. The expense of this will not much exceed 100*l.*

Exclusive of the argument for extending the north pier, or forming a permanent north, which I stated in my report already referred to, the observations lately made by Mr. Timperley, on the direction of the current upon the bar, at the time of its greatest velocity, and upon the force of the tides, afford a proof of the expediency of a further extension.

That the depth of water upon the bar is the effect, not of flood-tide at sea, but of the ebb-tide out of the harbour, is evident, from the velocity of the latter being very considerably, often double the former, so that I think the entire exclusion of the flood tide from operating upon the bar would do little evil, while the protecting the current out of the haven, from the cross action of the weaker sea tide, and confining it to one channel, would be of the greatest consequence. At present, the current is carried in a diagonal or north-east direction over the bar, and with a reduced velocity not much exceeding half its velocity when between the piers. An extension of the north pier would evidently in some measure prevent this diminution of velocity, and carry out the matter of the bar into deeper water and a stronger tide, while the velocity of the tide at the end of the pier would be increased by the extension of the pier, and by the consequent formation of the dry land or shore farther to sea-

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ward, forming the entrance of the harbour more into a projecting point, upon which the current would naturally be stronger than upon a straight part of the shore.

As the preparations upon the north pier for assisting ships into the harbour have been entirely useless, I think the construction of the additional part may be confined entirely to the objects I have mentioned, by which great expense will be saved, as respects the height of the pier and the planking of it, both of which may be added afterwards, if found necessary: neither would I, at first, close the pier higher than about three-quarter's flood, but so form it as that it may at any time be entirely closed to above high-water, as I have recommended being done with the part already built.

A light-house, at the outer end of the north pier, might, I conceive, form a useful finish to it. The depth of water upon the bar might be shown by signals from it during the day, and the light be made revolving, and so constructed, as to show by the time of each revolution the depth at the entrance in stormy weather, if this should be thought desirable.

I have had the soundings extended round to the end of the south pier, my opinion being, that the depth of the passage there also will be increased. As things now are, there is a considerable indraught into the river during the flood by the eddy tide, which is caused by the projection of the piers and land on the north side of the entrance beyond the bay, which extends quite to the cliffs on the south side. When the north pier is extended, this eddy tide will be stronger; and as the pier will rather act as an obstruction to the river receiving its supply in the direct line, a greater quantity will be drawn in round the south pier, and the depth considerably increased; for the depth of water in this line is, I conceive, due to the current of flood, and not of ebb. Besides the addition to the depth of the water, of which the benefit would be general to ships at all times, the extension of the north pier would also be useful to vessels going out of the harbour, particularly during easterly winds, as it would protect them to a greater distance from the land, and consequently prevent the danger they are at present subject to, of being blown back upon the shore, before they have got away enough to carry them clear of it.

The proposed addition I would recommend being made nearly in the line of the north pier, the inclination of the outer end rather to the north, and with a very small curvature at the extreme end convex to the entrance, according to the plan.

The length to which I think it should be carried is 200 yards, which will protect the current clear of the bar; but one half of this might be finished, and its effects ascertained, which can in future be easily done at any time, from the surveys and soundings lately taken.

Although, however, the execution of a part may be expected to do some good, its effects will by no means be in proportion to the whole, because it is towards the outer end, where the current of the ebb tide turns the stream of the haven's water into the northerly direction, and breaks its force, that the proposed extension will be useful.

The cost of the work will be about 13*l*. per foot in length.

I have directed my attention to the practicability of increasing the quantity of scouring water, which would in effect be the same as improving its direction. This is to be done, either by the more free admission of tidal water into the river, so as to increase the height of the surface now covered with water, or by forming an artificial back-water, to be let out by sluices at the time when it would produce the greatest effect.

With a view to the former of these objects, I have had the ground between the sea and the bottom of Braydon surveyed and levelled by Mr. Timperley, to enable me to judge of the effect, and to calculate the expense of erecting sluices that would admit the water of the flood, and which being shut during the ebb, would discharge all the water received through them into the course of the river and out at the entrance; and as I have found, by accurate levelling, that the average high water of the Braydon from Yarmouth bridge upwards, is one foot lower than the high water level at the haven's mouth, and at extraordinary tides more than three feet, there is no doubt that a direct communication between the sea and the Braydon would bring in a great additional quantity of water: but as the expense of forming and maintaining the passage would be very great, owing to the depth and loose nature of the ground; as the water thus received would go off chiefly at high water, when its effect upon the bar is of no value; and as the measure might be objected to by the land owners, I would recommend that this plan be laid aside at present, and that the improvement in the waters of the Braydon be confined to the more legitimate mode of removing, as far as may be practicable, the obstructions in the passage between the haven's mouth and Braydon.

The other method I referred to, is the formation of a basin, with sluices, to be opened at low water. This would certainly be less objectionable and more useful than the plan of sluices between the sea and Braydon; and there is ground near the entrance, upon which a basin of fifteen to twenty acres might be formed.

The expense of the work would, however, be great, probably not less than 20,000*l*.; and while the ebbing water takes the direction it does at present, I do not calculate upon effects at all commensurate with that expense.

The formation of sluices in the course of the river, near the bridge, to be opened at low water, has also been considered by me; but it is liable to similar objections as the former; and upon the whole, my opinion as respects the bar is, that to improve the direction of the effluent water, by means of a permanent North, so as to collect the force of the ebb, and to bring the passage of the water and of ships more nearly into the same course than it is at present, is the cheapest and best plan, and that its effects should be tried before any of the other and more expensive methods be attempted.

After the bar, the river between the Yare and the haven's mouth claims attention. The various engineers employed by you at different times have agreed as to the propriety of bringing the navigable channel into a regular line and section, by means of a dwarf piling, and of removing the shoals and impediments, which are caused by the present irregularities. The effect of this would be not only the deepening of the river for the passage of ships, but by the removal of the most projecting obstructions to the current of the tides, a consequent improvement of the entrance and bar. At present a tide, which rises five feet six inches at the haven's mouth, rises only two feet six inches at the bridge, being a difference of three feet, of which one foot is the high water difference (the horizontal level of the water, at that time, being one foot higher at the piers than at the bridge), and two feet is the low water fall or inclination in the surface of the river downwards. At low water, with higher tides, the difference is still greater. Now it is evident that the unequal widths and depths, and the sudden bends, are the causes of these great falls; that inasmuch as we can remove the cause, we shall lessen the effect; and again, that the depth upon the bar is effected principally by the quantity of water which

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passes over it at low water. So soon as the dwarf wharfing is done, the ballasting engine should follow it, and the excavated soil be laid with a regular slope, and under the particular direction of the resident engineer, so as to bring the section of the river up to high water level, to form with a determined line a length at the upper end of the Brush, and on the opposite side of the river should be done in a more substantial manner, and with larger piles, for ships to lie against.

The cost of the dwarf wharfing will be about 8*s.* per yard; that for the ships, and that in deeper water, will be much more expensive, viz, the former about 8*l.* per foot, and the latter 25*s.* per foot. I anticipate important good from this measure; and as respects this and the other work I have recommended, I would remark, that the present prices of materials and labour are favourable for their execution.

Gauges have been fixed at the end of the north pier, at Yarmouth bridge, and at Burgh deeps, all level with the index at the Brush, and accurate observations, for a series of tides, have been made upon them, all with a view of ascertaining the effects of the recommended measures. The observations I will deliver to you.

At the meeting of the Commissioners I attended in August last, I was desired to consider the subject of the bridge, and to prepare a plan for a new one. I have since conversed with some of the Commissioners on the subject, and have been led to suspend a compliance with the order for the present. As respects the impediment to the passage of the water under the bridge, the evil might be lessened by deepening under it towards the sides of the river, particularly the east side, and by preventing vessels from lying so near it; if they could be kept fifty yards from the bridge below it, and thirty yards above it, much of the obstruction would be done away. While I was at Yarmouth, about three weeks since, four loaded vessels were lying below the bridge, and almost close to it: this is a very bad way of lessening the evil of a contracted passage.

If the improvements, which I have referred to, are to be proceeded on with spirit, a steam dredging engine will, I think, be required; the present one is, besides, apparently worn out in the service.

If you resolve upon this, there may be an opportunity of purchasing one that has been made for another work; but as your use of it will be permanent, it will be economy to have at once a good engine in a strong vessel. It is not impossible that such a machine may be used with effect in ballasting ships from the bar, particularly when, by extraordinary winds or otherwise, it rises above its average level. The ballast taken from the Thames has the double object of removing the shoals in the river, and the principle may to a certain extent be applicable at Yarmouth.

The sloping wharfing, at the Anchor and Hope, is in progress: a considerable length is done, and I think it will answer the purpose of preventing the inroad of the sea at that formerly very dangerous place.

I beg to transmit herewith an estimate of the works ordered at the meeting of 13th June.

I am, &c.,

J. WALKER.

To Samuel Tolver, Esq.,
Clerk to the Commissioners of Yarmouth Haven and Piers.

Estimate of the Works resolved, at the Meeting on the 13th June, to be immediately proceeded with.

		£.
200	lineal feet extension of North Pier, 13*l.*	2,600
400	Ditto wharfing at upper end of the Brush, 8*l.*	3,200
800	Ditto of dwarf wharfing, where the water is deep, from opposite the upper end of the Brush towards Yarmouth, 25*s.*	1,000
2,000	Ditto of dwarf wharfing, on the east and west sides of the river, from a little above the Brush to upper road leading to Gorleston, 8*s.*	800
	Planking the present North Pier to high-water mark	100
		£7,700

The above is a net estimate of the works, exclusive of the expense of ballasting, to deepen the river, and fill up behind the dwarf wharfing.

Much of the excavated soil will, I think, be fit for ballast, and may be so disposed of.

No. 249.

Complaints of the General Steam Navigation Company.

No. 249.

Complaints of the General Steam Navigation Company.

Yarmouth Quay, 20th Oct. 1845.

SIR,

I beg to request your attention to section 126 of the Haven and Pier Act, 5 and 6 Will. IV., which authorizes the invidious and oppressive tax of 4*d.* per ton exclusively upon vessels not registered in the port of Great Yarmouth.

This Act is most ambiguous in many instances, and it is especially desirable that the sections authorizing the levying of dues, and for ascertaining the weight of goods should be defined; *ergo*, ss. 42 and 126, "Fish, green or partially cured, are excepted from dues."—What is the meaning of partially cured? Sec. 59, "Forty cubic feet of light goods are to be considered one ton."—What are light goods?

The Act evidently contemplated that non-resident Commissioners would take an active part in the management of the haven, hence the limitation of expenditure by local Commissioners to 100*l.*, and the provision that upon important occasions the non-resident Commissioners should be present and vote. But the experience of ten years has convinced me that these precautions have failed; and I feel assured that the harbour would be more likely to have its capabilities developed, and that the management would be more impartially administered if persons disconnected with the locality had a share of the control.

How is it that the steam shipping is wholly destitute of accommodation, having no place wherent to discharge or load, whilst central parts of the quay are occupied by, and apportioned to, corn, coal, and other sailing-vessels, many lying light?

How is it that there is no light at night, nor flag by day, to denote the depth of water on the bar?

These defects are attributable to the constitution of the controlling body, and can only be amended by an amendment of the system.

No. 249.
Complaints of the General Steam Navigation Company.

I am, &c.,
JAMES CHERRY.

Joseph Hume, Esq., M.P.,
&c. &c.

No. 250.
Correspondence relative to the Plans of the Harbour.

No. 250.

MR. TOLVER'S *Letter, stating that the Commissioners had no Charts of the Navigation.*

SIR,

Great Yarmouth, 20th Oct. 1845.

Your letter of the 18th I have to acknowledge. I am not aware of any map of the whole of the navigation of the Bure, Yare, and Waveney, or any reports of their extent, &c., nor of the surface of the roads, marshes, and dykes covered with water at high spring tides.

The plans of the bridge contracted to be built are with the engineers, Messrs. J. B. and E. Birch, in London, excepting a design or sketch of the bridge.

I shall be able to show the causes which prevented the works being proceeded with.

Mr. Walker's plans were returned to him, but the Commissioners hold his correspondence on the subject of the bridge.

I shall attend your appointment this evening at 7 o'clock, and give such further explanation as you may require.

I am, &c.,
SAMUEL TOLVER, *Town Clerk.*

Joseph Hume, Esq., M.P.,
&c. &c.

No. 251.
Correspondence relative to the Harbour Accounts.

No. 251.

Correspondence relative to the Harbour Accounts.

SIR,

Yarmouth 23rd Oct. 1845.

I received your note this morning, requesting me to furnish you with an abstract of the moneys paid by the Haven and Pier Commissioners to each of the River Commissioners, and I beg now to enclose the same.

As treasurer of the haven and pier, I have no documents to furnish respecting the expenditure of the moneys paid the different River Commissioners. An order is made to pay the different treasurers, on which I act, and take a receipt. I am treasurer to the North River Fund, but I have no means of saying how, and for what, the moneys are drawn out, but I pay a cheque of one of the Norfolk Commissioners. Any further returns that may be required I shall feel it my duty to send in.

I am, &c.,
JOHN E. LACON, *Treasurer.*

Joseph Hume, Esq., M.P.,
&c. &c.

No. 252.
Notice of Meeting, Tidal Harbours Commission.

No. 252.

Notice of Meeting, Tidal Harbours Commission.

SIR,

15, *Duke Street, Westminster*, 13*th October*, 1845.

I am directed to acquaint you that this Commission will hold a Court in the town-hall of Yarmouth on Tuesday, the 21st instant, for the purpose of inquiring into the past and present state of the harbour and navigation of Yarmouth.

I have therefore to request that you will give notice to all the members of the Harbour Trust, to the County Surveyor, to the Resident Engineer, to the Harbour Master, to the Captain of the Pilots, to the chief officers of the Coast Guard, to all masters of vessels trading to the port, and also to any persons who may be qualified to give information on the points of inquiry generally mentioned in page 5 of the First Report made by this Commission to Her Majesty, a copy of which is herewith forwarded.

I have also to request that you and the treasurer of the Harbour Trust will be in attendance at the time and place specified, with the harbour books, accounts, all the maps, plans, and documents relating to the port which the Harbour Commissioners have in their possession, and that you will have ready prepared a list of the same for the use of the Commission.

I am, &c.,
COCKBURN CURTIS, C.E.,
Acting Secretary to the Tidal Harbours Commission.

To the Secretary of the
Harbour Trust, Yarmouth.

No. 253.
Copy of Notice.

No. 253.

Royal Tidal Harbours Commission.

London, 13*th October*, 1845.

Public notice is hereby given that this Commission will hold an open Court in the town-hall of Yarmouth, in the county of Norfolk, at 10 o'clock in the morning of Tuesday, the 21st October, 1845, for the purpose of inquiring into the past and present state of the harbour and navigation of Yarmouth.

All persons interested in the objects of the inquiry, and all who are competent to give information on the same, are therefore requested to attend at the time and place specified.

Notice is also hereby given, that similar Courts will be held at subsequent dates at the ports of Norwich Blakeney, and Wells, in the said county of Norfolk.

By order of the Commissioners,
COCKBURN CURTIS, C.E.,
Acting Secretary to the Royal Tidal Harbour Commission.

No. 254.

NORWICH.

Examining Commissioner—Joseph Hume, Esq., M.P.

Public notice had been given in the newspapers of the county, and by the Mayor in the usual way, and all persons officially connected with this navigation, and all who were interested in the inquiry, and competent to give information or offer suggestions, were requested to attend, and there were *present*:—Sir W. Foster, Bart., Mayor; W. Freeman, Esq., Deputy Mayor; J. Betts, Esq., City Sheriff; Mr. Springfield; Mr. S. S. Beare; Mr. P. Finch; Mr. E. Willett; Mr. J. H. Barnard; Mr. J. Wright; Mr. A. A. H. Beckwith; Mr. G. A. Dye; Mr. Tillett; Mr. Skipper; Mr. J. J. Blake; Mr. Staff; Mr. Chamberlin; Mr. Norgate, Mr. Hardy; Mr. J. Geldart; Mr. Barwell; Mr. Coaks; Mr. Bullard; Mr. O. Springfield, &c.

Evidence taken on the 24th Oct., 1845.

Mr. Samuel Spalders Brace, Haven and Pier Commissioner of Great Yarmouth, and Chairman of the Norwich River Committee.—Stated that the principal portion of the sums allotted to the Norwich River, by the Haven and Pier Commission, was expended in dredging between the New Mills and Trowse Hythe; the average expenditure in dredging was from 340*l.* to 350*l.* per annum; 80*l.* and 120*l.* were paid for piling the banks of the river; there were also incidental expenses, which together made up the 600*l.* annually allotted by the Haven and Pier Commission; the items of the expenditure would appear on the treasurer's account. This year a contract for about 270*l.* had been made for dredging between the New Mills to just below Carrow Bridge; about 80*l.* more would be expended in dredging other parts, and about 100*l.* to 150*l.* in piling. The committee were very desirous to keep the navigation fit for sea borne-vessels; the centre arch of Yarmouth Bridge would be 44 feet according to the plan which was proposed, but it was only in the last contract that they had been able to have that width, as the Yarmouth Haven and Pier Commissioners had always been desirous that Norwich should not be made a port. The average depth maintained by contract between New Mills and Carrow Bridge is from 5¼ to 6 feet; he considers that quite sufficient for the present trade of the port, but it is very desirable that sea-borne vessels should be brought up to Norwich. Attempts bad been made to effect this object, but through the opposition of Yarmouth they had been ineffectual.

Commissioner.—Do you mean to say that Yarmouth objects to sea-borne vessels coming up to Norwich?

Mr. Beare.—Yes, and so zealous are they that they also spent 6000*l* or 7000*l.* in attempting to prevent Norwich being made a port through Lowestoft; and it is notorious that if a communication with the sea through Yarmouth had been allowed, the people of Norwich would never have sought it through Lowestoft.

Mr. Beare was not aware that the late Mr. Rennie and Mr. Walker both recommended that the water-way should be increased by 30 feet at the Yarmouth Bridge; those reports were made before he became a commissioner. He did not know that it was proposed in the new bridge to decrease the present water-way six feet. The principal obstacle to sea-borne vessels coming up to Norwich was the shallowness of that part of the Breydon called the Burgh Flats, at the junction of the Yare and Waveney, where the channel was not sufficiently deep. The river from that up to Norwich was generally quite deep enough, and would only require to be dredged in one or two places in short distances. He was confident that the citizens of Norwich would not be satisfied until they could get vessels up from the sea to the city of 200 to 250 tons, and the River Committee were of opinion that by a judicious system of improvement vessels of from 250 to 300 tons might ultimately be brought up; and if vessels could be brought up direct to Norwich, it would prevent the necessity of transhipping their cargoes, as was at present done at Yarmouth, at increased expense and loss of time also.

Mr. John Handy stated that 170,000 tons of coals were annually returned from the Custom-house as imported at Yarmouth, and that, of those, 100,000 tons came up to Norwich; that it would be a great advantage, both as regards expedition and safety, if these as well as other goods destined for Norwich could be brought up directly in sea-borne vessels by the river.

Mr. Beare stated, that there was no physical obstacle to deepening the river to 12 feet throughout the whole distance. In the city, the river would require to be widened, by throwing down some buildings; the question was one entirely of expense; at present the Norwich Commissioners had to dredge the river down to Hardley Cross, the extent of their jurisdiction; and they were only allotted 600*l.* from the haven and pier revenue for that purpose; and that without Government assistance, or some powers being granted for raising the money, they could not carry out the improvements of which the river was susceptible. In regard to encroachments upon the width of the river, a water-bailiff was employed to prevent them, and he knew that at different times stages and other encroachments had been removed; and where they were allowed to remain, a small rent was paid by way of acknowledgment.

Commissioner.—I observe in the accounts sent me a charge of 11*l.* to 16*l.* for surveys. What is the duty of those who survey?—The committee of navigation go down once a-year from Standley Ferry to Hardley Cross, to examine the river, and remove nuisances. The water-bailiff attends to point them out.

Commissioner.—Did you ever make more than one survey of the whole of that part of the river which is under your jurisdiction?—Never more than once down to Hardley Cross; the other to Standley Ferry.

Commissioner.—In what way, then, did the expenses amount to 12*l.* or 15*l.* for one day?—We pay something considereble for the steamer; and then the committee dine.

Mr. Beare further stated, that the committee had not taken into consideration the effects that might be produced by a uniform tide scouring the bottom of the river, as they thought that that was the duty of the haven and pier commissioners; the committee attended to their own navigation, and they thought the higher the water was the better it would be for the navigation. The committee had no engineer or professional man to point out the places where the river should be deepened. They take a contract that a certain depth shall be preserved, from a certain point to a certain point, and they go once in one or two years, to sound and try the depth, in accordance with sec. 93, of the 5 and 6 Wm. IV. c. 49. Estimates were submitted to the haven and pier commission, before its first annual meeting, and the sum of 600*l.*, as already stated, was usually allotted for the clearing of the Yare.

Appendix B.

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Evidence taken on the 24th Oct., 1845.

Commissioner.—My question is, who pointed out the places to be estimated for?—No one; the committee saw the works when they were executed.

Who tried the depth before the works were begun?—No one.

Mr. J. O. Springfield, Haven and Pier Commissioner, did not know there was any necessity for the survey, it being done, as, by the employment of professional men, they would only have been reducing the small sum they had to devote to the improvement of the river.

Commissioner.—Might not the judicious application of 10*l.* do more good than the injudicious application of 100*l.*?—Certainly it might.

Mr. Springfield was aware that increased depth of water had been obtained, not only in the harbour, but on the bar, by dredging the channel and by piling the sides of the inner part of Yarmouth Haven. The attention of the Haven and Pier Commission had been directed to the narrowness of the Yarmouth Bridge; the Norwich commissioners were most anxious to get one which would admit seaborne vessels; increasing the general width of the waterway at the bridge had not been considered. Mr. Walker's plan, of 1835, was opposed in 1842, because the centre arch was only 30 feet wide, and in answer to advertisements, several other plans had been received; of these four were submitted to Mr. Walker for his opinion as to which of the four was the best, and that which he selected as the best was adopted. If Mr. Walker had thought that it was an improper one, it was his duty to have stated it, as he was requested to make a full report on the subject. The Haven and Pier Commissioners were unanimously of opinion that Mr. Walker's plan was not a good one; he believed Mr. Walker was in a degree offended because his plan was not adopted. Mr. Walker wanted his plan back again, and the commissioners said they had paid for it and would not return it; but, after considerable correspondence on the subject, Mr. Walker returned the money, 100*l.*, and received back his plan. He believed that Mr. Walker had not been consulted by the Haven and Pier Commission since that time. When he (Mr. Springfield) became a member of the Board, he found a debt of 700*l.* or 800*l.* due to Mr. Walker; it appeared to him that the charges were very heavy. Mr. Walker was paid for his trouble, and the commissioners had not employed him since; but all improvements had been conducted by Captain Smyth, under their own observation. On the Norwich river no professional men had been employed, except when it was proposed to improve the state of the river running through the city. Mr. Edwards, C.E., was then called in, and gave plans and sections of the proposed alterations, which he had prepared from the New Mills to Bishopsgate Bridge, and for widening one part called Hell Hole. He estimated the cost at from 2500*l.* to 3000*l.* In effecting this, an additional grant of 1000*l.* was made by the Haven and Pier Commission, and the whole was satisfactorily done for 1200*l.*, under directions of their committee, with the assistance of the Norwich commissioners and city surveyor. No professional opinion had been taken as to what ought to be done between Bishopsgate Bridge and Hardley Cross, but the committee, several of whom were barge-owners, had taken the practical advice of the navigators, and that they had gone with them, from time to time, and taken the soundings. To show the vigilance of the committee, he instanced that during the last month the committee had found out that a contractor had dredged the mud out from one part of the river, and had thrown it into another.

Commissioner.—As you have no person whose duty it is to examine the work before and after it is executed, might this not have been done for several years back?—Certainly not; the committee inspected the river too thoroughly for it.

Mr. Springfield stated that there was no account kept of the goods which came up to Norwich; the tolls were let for 1300*l.*, therefore no account could be given. Formerly the tolls were collected, and only 600 or 700*l.* a year used to be received. 12½ per cent. used to be paid for collecting, and a large house was kept up for the establishment. The maximum sum now levied was 3*d.* a-ton; and on sugar and a variety of heavy goods, only 2*d.* Goods could come up from Hardley Cross to within a mile and a half of the city without paying anything.

Mr. John Rising Staff, Town Clerk to the city of Norwich, stated, that the dues were only charged upon goods coming into the city, and that the sum for which the tolls were let was expended on city improvements.

Mr. Beare stated, that a portion of the money was expended in keeping St. Andrew's Hall in repair.

Mr. Springfield stated that no record was kept of the rise and fall of the tide; that until lately it had not been perceptible, but the improvements of the haven and opening the Lowestoft navigation now occasioned a rise and fall of perhaps 12 or 18 inches. He also thought, that if the Norwich river were dredged and straightened some miles down the river, where requisite, as well as the haven, great benefit would be derived from it. He thought Yarmouth Bridge, as it at present existed, with the piles and coffer-dams for the new bridge, was a great impediment to the navigation; and that it would not be suffered to remain if it were not under litigation. The Norwich river, from the New Mills to the Foundry Bridge, had been dredged to 6½ feet, from the Foundry Bridge eight feet down to Thorpe, and from that to Hardley Cross, the depth averaged 12 feet throughout.

Mr. John Norgate, merchant, was of opinion, that if the navigation were sufficiently improved, foreign vessels might come up to Norwich direct. He stated that the grocery vessels employed in bringing goods to Norwich were of 130 tons; oil-cakes were brought over from Holland to Yarmouth, in vessels drawing from seven to nine feet water; timber-vessels drew from 14 to 15 feet, which he thought was the depth which ought to be obtained in the Norwich river.

Mr. Richard Bullard, merchant, a member of the river committee, remarked, that for 25 miles in the Norwich river, there was a uniform depth of from 10 to 14 feet. He thought nature had given Norwich abundant materials for commercial prosperity, but her citizens had made a very bad use of them.

Mr. Springfield drew the attention of the Commissioner to the very small charges (only from 2*d.* or 3*d.* a-ton) on inward freights, and stated that there was no charge at all on exports.

Mr. Barber, merchant, stated that, before the harbour at Lowestoft was opened, 20 per cent. was charged for re-shipping London goods for Norwich in the small craft; but when the Yarmouth traders found that sea-borne vessels came through Lowestoft directly up to Norwich, they delivered goods at Norwich at the same price they did at Yarmouth; hence the freight on goods from London by the opening Lowestoft harbour was reduced one-fifth; but expense was not the only consideration, for the

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No. 254.

Evidence taken on the 24th Oct., 1845.

delays occasioned by unloading and transhipment at present was a serious loss to the Norwich merchant; as, for instance, a vessel would arrive in Yarmouth on a Tuesday; the first part of her goods would be started off the same day, while, perhaps, the remainder would not be sent for the next two days. It was also necessary for the craft to sail away by the first set of the flood, and if they did not, they would have to wait for the next tide. He had been a shipper of goods for 30 years, and had generally found that no exertions were wanting on the part of the persons employed in the conveyance of goods. Accidents seldom occurred, but still the saving of time by seaborne-vessels bringing their cargoes direct up to Norwich would be so great, that he thought it would be most important for Norwich if it could be effected.

Mr. S. O Springfield, as well as the last witness, was of opinion, that the Yarmouth and Norwich Railway could not possibly compete with an efficient ship navigation; the pilferage which takes place in transhipment would alone occasion the preference to be given to the navigation; and that, in the event of its being made to Norwich, the Yarmouth ship-owners would not find their coasting trade cut up by the railroads.

Mr. Coaks said, if the bridge contemplated to be built over the river, by the railway, at Reedham, was carried into effect, it would impede the navigation very much, because it would be necessary to build a pier in the very middle of the stream to support the arch.

Commissioner.—Why was not that part of the bill relating to the bridge opposed in Parliament by those whose duty it was to guard the interests of the navigation?

Mr. Coaks.—They did make an opposition, but how far they did their duty I cannot tell.

Mr. Springfield.—I was one of the deputation which attended the Committee of the House of Commons. We wanted to be heard by counsel; the counsel for the bill argued against us, that the bridge was below our jurisdiction; but we pleaded that, though below, it was between the sea and our navigation. The Committee would not, however, hear us; we then petitioned the house, and that was referred to the same committee, which had already refused us a hearing; and we were obliged to submit to the bridge being erected.

Mr. E. Willett, manufacturer, confirmed the statements made by Mesers. Springfield and Beare, and bore witness to the inconvenience caused by the delay of unloading, and loading again, at Yarmouth. He also thought it most desirable, that all bridges built across the river should be large enough to admit the London steamers.

Mr. John Maroate stated, that the narrowing of the Yarmouth bridge even now prevented goods from coming up to Norwich. The "Albatross" steam-vessel, plying between Yarmouth and Hull, would easily come up, if she could get through Yarmouth bridge; she measured 36 feet across the paddle boxes, while the opening arch of Yarmouth bridge had only 22 feet 6 inches span. He was part owner himself of the "Ailsa Craig," another steamer trading to Yarmouth; and so much did her owners feel the inconvenience of not being able to get her up to Norwich, that they had determined to build another steamer for that purpose.

Mr. S. O. Springfield stated, that this single fact, of the desire of the Yarmouth people to keep their bridge narrow, proved their jealousy of Norwich, and that in the last meeting but one or two of the haven and pier commissioners, Mr. George Danby Palmer, the haven and pier commissioner of Yarmouth, moved that the bridge upon the plan as proposed at present (giving a centre arch of 44 feet) should be abandoned, and that another bridge should be built, in which none of the arches should be more than 30 feet; in which motion he was seconded by the other two Yarmouth commissioners.

Commissioner.—Am I to understand, then, that the Yarmouth commissioners have, in their proceedings at the Board, opposed the widening of the bridge, to prevent increased facilities to Norwich?—Most certainly.

Mr. Springfield thought that a chairman appointed by government, to preside at the board of the commissioners, with a power of control to be used for the good of the public, would be desirable; but he considered the expense of government commissioners, if they were paid, would be greater than the benefits to be derived from their appointment. A controlling power to regulate, unattended with expense, would be well, but he considered the representative power ought not to be taken away. It was his opinion that an addition to the present Commissioners by the government would be a useful alteration, and serve all the national purposes that could be desired.

Commissioner.—Would any person present have any objection to that arrangement?—This question was unanimously answered in the negative.

Mr. Beare said, when it was proposed to make the arch of the Yarmouth bridge 44 feet wide, it was only negatived by 7 to 5. The Yarmouth people always opposed it, but their influence was overcome by the general good sense of the other commissioners.

Mr. J. Geldart stated, that the question of making Norwich a port, through Yarmouth, had been mooted as far back as 1818. The principal promoter of the scheme was Mr. George Brown, then deputy-mayor of Norwich; but he was threatened by the Yarmouth corporation, that any attempt to bring a ship to Norwich through that port would be opposed by every means in their power, and it was asserted by them, that to bring ships past Yarmouth was contrary to their charter, and an infringement of their vested rights. Mr. Cubitt was the engineer employed by the Norwich corporation, and he proposed to cut a channel by the side of Braydon, so as to avoid the shoal part, through which he thought it useless to cut a channel, as he considered it would never keep itself clear. No attempt was made to open a communication to the sea by the way of Lowestoft, until the Norwich traders had been repulsed at Yarmouth.

Commissioner.—What is the actual depth of water from the harbour to the Yare?

Capt. Smyth, pier-master of Great Yarmouth.—The lower part of Braydon is generally from 8 to 10 feet, the upper part 6 and 7. But a portion of Braydon, between the Upper Cross and the Berney Arms, has never been more than 5½ feet.

Have you any instructions to dredge that part of the river, or are there any restrictions?—I have no instructions; I have made no representations, because the depth of water there has been sufficient for the craft that have been up hitherto. If it were wanted for larger vessels, it must be deepened.

Do you see any difficulty in that being done, if orders were given and funds provided?—Certainly not.

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No. 254.

Evidence taken on the 24th Oct., 1845.

What time would it take to remove it?—I think from six to seven months.

Could it be done within a year?—Yes.

With one engine?—Yes.

How many horse-power is your engine?—Six horses.

Working how many months?—We can work from April to generally the beginning of December.

What prevents your working between that time?—We are in danger of freezing up.

Do I understand you, then, that no obstacles exist to a channel of 10 feet water being completed from Yarmouth to Hardley Cross in a year, if the necessary funds be provided?—None.

Do you think it would be proper to deepen that channel to that depth so as to admit vessels of 130 to 150 tons in that time?—I should skim over the ground, and go over the same portion next year. There is a great portion of the channel taken up. When I talk of one summer, I allude to that portion that is 5½ feet deep, but it would take three or four months more to make the whole complete.

Do you think that deepening that part would benefit the channel generally?—I think it would.

Mr. GELDART.—Mr. Cubitt said, that if Braydon were deepened, it was a soil so soft, that it would always flow back; therefore, to meet that difficulty, he proposed to cut a channel to Yarmouth through the marshes on the south side of Braydon.

Mr. T. O. SPRINGFIELD.—It so happens, that the channel, where it is deep, is perfectly clear. I am convinced it would take but a small expense to keep it up. We have shown by actual experiment, that it would scour itself, if we once set it free.

No. 255.

Cubitt's Report on Improving the Navigation.

No. 255.

Mr. Cubitt's Report on Improving the Navigation.

SIR,

I beg to state to you, agreeably to the instructions of the Committee for Improving the Navigation, I have examined the river from Norwich to Yarmouth, in order to form plans for and estimate the expense of making the same navigable for vessels not exceeding one hundred tons burthen, or drawing more than eight feet water, and have taken accurate surveys at such places as will be necessary to make alterations in the river. Plans of which surveys, with references thereto, are annexed to this, to which I shall refer for more minute explanation, and proceed to state the general plan there laid down, with the reasons which induced me to adopt that in preference to any other which offered itself.* From the Foundery New Bridge, at Norwich, to Thorpe, the river varies in depth from four and half to nine feet, and in some places more, with a bottom capable of being deepened to any extent that may be desirable, and of sufficient width, except from the Foundry Bridge to the boundry of the Dean and Chapter's Land just below Carrow Bridge; in this part it would not be proper to give it more depth without an additional width, as this part of the river runs quite close to the buildings, warehouses, and wharfs in King-street; for should it be sufficiently deepened in its present width, the shores would be too steep to remain good, and this steepness would endanger some of the buildings, the foundations of which are not so deep as the bed of the river would then be; and this being also the place where the greatest part of the business of taking and delivering cargoes would be done, it must necessarily be wider on that account, and in order to allow room for vessels lying, turning, passing, &c. besides the proprietors of property on King-street side would by this means be enabled to construct quays a little further into the river, which would secure the present buildings, and at the same time make them much more commodious.

From Thorpe to Witlingham the river begins to deepen, and from thence to Burgh Flats, (a distance of near twenty miles,) it will require little or no alteration, except a slight shoal or two removing, or sharp bends taken off. Thus it appears that from Norwich to Burgh Flats the river presents no impediment to being improved in its present natural course by deepening, &c. where necessary; but at this place the case begins materially to alter, for instead of deepening the present course of the river, the best method appears to be to make a new cut close along the south side of Breydon, so as to discharge itself into Yarmouth Harbour, at a place called the Knowl, and then turn both the Norwich and Beccles rivers into this channel by means of an embankment across the narrow parts of Burgh Flats; thus the water of both rivers, by being confined to a narrow channel, would tend to scour and keep open the new cut, which effect is now entirely lost by the sudden spreading of the water upon the Flats; this is further confirmed by the sudden shoaling of the water from thirteen feet at the mouth of the Norwich river to three and half feet, and frequently less on the Flats in a distance of less than two hundred yards. Should a channel be formed by artificial means through the Flats and that part of Breydon now too shallow, and which, on account of the depth wanted, should be extremely doubtful, there is every probability that it would soon silt up again for want of a current, as the ebbing and flowing of the tide in this place would only increase instead of diminish the evil, by the falling water drawing the silt into the channel without having sufficient force to take it away, which in this place could only be obtained by embanking the channel, to confine the water from spreading, and the evil would still exist wherever the embankment might terminate up Breydon; and even supposing the channel of Breydon to be embanked within its own bounds for the whole length, (which would certainly render the navigation deep enough,) then those who contend that the reservoir of Breydon is a preservative to Yarmouth Harbour, would of course complain of the ruin of it; but be that as it may, I presume the plans here laid down will answer every purpose required at the least expense, and also leave Breydon with all the advantages it now possesses with respect to the harbour.

W. CUBITT.

To Alderman J. Patteson, Esq.,
Chairman of the Committee, Norwich.

The Committee add to this Report some more information obtained from Mr. Cubitt, the engineer, on the subject of the proposed *new cut close along the south side of Breydon, to receive the Norwich and Beccles rivers*, part of the waters of which, if necessary, may be let off the cut on Breydon by proper sluices. Much stress has been laid, by intelligent persons, on the necessity of the Breydon back-water, to scour and cleanse the Yarmouth Harbour. Now if this be really necessary,

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* The estimate attached, including purchase of lands, dredging-machine, expenses of obtaining Act, gives a total of 35,626*l.* 16*s.*

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the power of the back-water will be increased by the contents of the new cut, estimated at fifty acres of surface and nine feet depth of water. This new cut must therefore prove a great benefit, and materially assist in obtaining and securing the very desirable object of scouring and cleansing the Yarmouth Harbour. Mr. Cubitt proposes to leave Carrow Bridge as it now is, for the use of the public above, and of the wherries and boats below; and to make a cut at the north foot of it, for sea vessels to pass above that bridge into the intended harbour or basin, which is to be made of sufficient breadth *to allow room for vessels, lying, turning, passing, &c.*, by cutting away part of the meadow extending along the river to the west. A proper bridge will be provided to pass over this cut.

By a reference to this it appears, that only from the Foundry Bridge to Witlingham, a distance of about two and a half miles, does the river want deepening, and that not to any great extent, as there is already six and seven, and in some places eight and nine feet water.

From Witlingham to Burgh Flats, a distance of twenty-two miles, it will be seen by the scale that nature requires very little assistance, there being already, except in a shoal or two, much more water than there generally is upon Yarmouth Bar.

The proposed new cut would be rather less than three and a half miles long, the expenses of excavating which can be ascertained within a few pounds, as there are many persons who would be now glad to enter into a contract for the performance of it.

No. 256.

Telford's Report on the proposed Improvements.

No. 256.

Mr. TELFORD's *Report on the proposed Improvements.*

London, 12*th December*, 1822.

HAVING examined the several plans and documents relative to proposed improvements in the mode of water conveyance between the City of Norwich and the sea, and having examined the rivers by which these are to be accomplished, I beg leave to state, that I found—

1st. Mr. Cubitt's representations to be correct, and his observations such as to show that he had carefully considered the business with which he was intrusted. In passing along the rivers, &c. I proved the depths, as stated by Mr. Cubitt, to be sufficiently correct to afford data for a general report, which is all I can, at present, presume to furnish.

2nd. I understand that the main object had in view by the promoters of this scheme, is to avoid transhipping at Yarmouth; and in order to accomplish this, to have a depth of river, &c. between Norwich and the sea, to admit vessels drawing ten feet water to navigate quite up to the city; and that my opinion is requested whether this can be procured, and at what expense?

3rd. That a depth suitable for vessels drawing ten feet can be had, at a comparatively moderate expense, is undeniable. The extensive flat of marsh land, between Norwich and the sea, and the present state of the rivers, are peculiarly favourable; by much the greatest proportion being now of sufficient depth, and the little required to be deepened, presenting no obstacle but the expense. These observations in a great measure apply to both the plans which have been proposed, to near the junction of the Yare with the Waveney, and are equally desirable for both.

From this point the earliest proposition was to proceed by the united rivers Yare and Waveney to Yarmouth, and the latter scheme by the river Waveney and some lakes, &c. to Lowestoft.

4th. If the earlier project had been adopted, the shallow lake Breydon was to have been avoided, by a new channel excavated along its southern side, through which the united waters of the Yare and and Waveney were to have been conducted to the general channel previous to entering the town of Yarmouth.

The merchants and traders of Norwich, having experienced vexations, delays, and losses from transhipping at Yarmouth, and having become desirous of keeping pace with the general progress of improvements in other parts of the country, seem justified in forming the scheme of acquiring a free navigation for small coasting vessels drawing ten feet of water; and while this was to be accomplished without forsaking the ancient port, or eluding its dues, any serious opposition could scarcely have been anticipated.

I am further led to hope for the desirable co-operation of Yarmouth and Norwich, because, as an engineer, I can foresee no injury to the harbour or port of Yarmouth, from the New River Channel, along the south side of the Breydon Lake, while the tidal waters are left a free admission into both the Lake and New Channel. And I am persuaded that the late eminent engineer, who hinted a different opinion, has not proceeded with his usual caution and accuracy, in examining the premises himself, or procuring sufficiently correct data: because I am convinced that it has been from the purity of the tidal waters, and not the scouring of the river waters, that Breydon Lake has so long remained of its present dimensions. As a harbour scour by the ebbing tide, there would, in addition to the lake, by the proposed scheme, have been the whole quantity of water contained in the New Channel, that is to say, about fifty acres.

5th. But in consequence of a declared or understood objection on the part of the town of Yarmouth, the second scheme, of proceeding to the sea at Lowestoft was suggested and surveyed. To accomplish this, the river Yare was left at Reedham, by a new cut of 2½ miles, which joined the Waveney a little above St. Olave's Bridge, and proceeded along that river, the Oulton Dyke, and Lake Lothing, to the shore at Lowestoft; with which a communication was to be made by a short cut through the bank which divides that lake from the sea.

To this scheme there is no physical obstacle; the Waveney is already of sufficient depth, Oulton Dyke may be rendered so; the sea bank may be cut; and a proper lock, and also regulating harbour gates may be constructed; no water would be abstracted from the Waveney, excepting lockage into the interior harbour at low water, and that may be compensated, to any prudent degree, by tidal water at high water. This capacious interior harbour, of a mile in length, would not only prove a convenient and safe receptacle for both trading and fishing vessels, but would also, if necessary, act as a powerful scouring basin to the new entrance.

The shore, where this entrance would be, has remained for many years very steep, and is quite clear of mud: from the general shape of the shore on each side of Lowestoft Ness or point, there is a safe roadstead either on one side or the other.

6th. From the foregoing statements, it will be evident that both of the proposed schemes are practicable, and that each has its comparative merits. That of Yarmouth has the disadvantages of a very rough tempestuous shifting bar and entrance, and is encumbered with port dues, &c.; but has the benefit of an established port, and of being the outfall of three extensive rivers. That by Lowes-

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toft has the disadvantage of being more costly in the construction, and having new establishments to create; but has the benefit of being adjacent to safe roadsteads at sea, having an entrance free of bar, an extensive interior harbour, and a freedom from port dues. The interior or river navigation I conceive would be nearly on a par.

I therefore do not hesitate to give it as my opinion that a conveniant and safe navigation for vessels drawing ten feet water, may be constructed between Norwich and the sea at Lowestoft. But although the apparent advantages seem to be in its favour, yet from Yarmouth being an established port, being the outfall of three considerable rivers, and it being desirable to concentrate rather than distract the general efforts of the adjacent towns and districts of country, so as to maintain one good port, I recommend that Norwich and Yarmouth confer, in a liberal and friendly manner, how to improve the navigation between these two places, so as to admit of vessels drawing ten feet water, without interfering with the port dues, &c. of Yarmouth.

If this can be effected, all parties should cordially unite to render the improvements as perfect as possible: and, considering the importance of the objects had in view, the expense is comparatively inconsiderable.

From the data with which I have been furnished, and the general inspection which I have made of the line of each project, I have made estimates of the expense, which although rather more than those made by Mr. Cubitt, yet have nearly the same ratio to each other. I make that by Yarmouth 48,738*l.* 10*s.*, and that to Lowestoft 95,760*l.* Neither of which ought to stand in the way of such an important and desirable improvement.

Thos. Telford.

No. 257.
Walker's Report on making Breydon navigable.

No. 257.

Report on the practicability of making Breydon navigable for vessels drawing 10 *feet water, &c., by* James Walker, Esq., C.E.

Limehouse, 4th September, 1826.

Sir,

The resolutions of the meeting of the commissioners of the haven and piers, held the 8th of August, as respects me, are—

1st. That I survey the rivers, so far as is necessary, and report on the practicability of making Breydon navigable for vessels drawing 10 feet water.

2nd. That I report my opinion of the effect which a lateral cut from above Yarmouth bridge to Burgh flats, so as to avoid the navigation by the Breydon, would be likely to have on the river Bure.

Having, in compliance with the above resolutions, attended at Yarmouth, and made the necessary surveys, having referred to the plans and sections made by Mr. Timperley, and having given the subject my best consideration, I have no hesitation in replying to the first inquiry, "that Braydon may be made navigable for vessels drawing 10 feet water."

It will be expected that I state generally my reasons for this opinion; and with a view of being on the secure side, I shall suppose the question to have reference to low water.

I find the whole length, between Yarmouth Bridge and the river Yare, to where that river is upwards of 10 feet deep at low water, to be 4½ miles, of which the three-eights of a mile nearest the bridge has an average depth of eight feet at low water, the next mile is nine feet deep at low water, and for seven-eights of a mile beyond that, nearly up to the Middle Cross, the depth is already 10 feet; so that the lower 2½ miles would require but little to be done to it, in order to render it navigable for vessels drawing 10 feet; and it is important to observe, that the present depths are all the effects of natural causes, this part of Breydon never having been dredged or didelled, so that there is no fear of incurring expenses to preserve the depth in future. But in the two mile above this, or from below the Middle Cross, all the way to the mouth of the Yare, a good deal of work will be required to accomplish the object, the average depth of the whole of that length being only five feet in the channel, and not more than four feet to four feet six inches for the width required for a commodious navigation.

I have calculated that these two miles will require the excavation of 240,000 cubic yards to form a navigable channel 10 feet 6 inches deep at low water, and 100 feet wide; and if to this be added 60,000 yards for the part between the Middle Cross and the bridge, the whole quantity of didelling will be about 300,000 cubic yards, which, at 6*d.* per cubic yard, amounts to 7,500*l.*, exclusive of the use of the dredging engine, and the expense of some barges, which together may amount to 1,500*l.* more; and this appears to me the whole expense of the excavation.

With the new engine, which has been ordered, the work may be completed in from two to three years from the time of commencement.

I have stated that the lower part will require little or no expence to support its depth; and although the matter brought up along with the sea-water is chiefly deposited before it reaches the upper part of Braydon, it is not to be expected that the scour of the rivers or of the tide is, without some expense, to keep open an artificial channel of 10 feet in depth, when the natural depth is not more than 5 feet, unless some means be taken to confine the current of the tide, and to give it the proper direction.

But this may, I think, be done; and that the effect will not only be to keep the channel open, but to tend to the safer navigating of Breydon, by keeping the vessels from being acted upon by cross currents.

The current from the Yare and the Waveney, after getting out of Burgh flats, is spread over a great width, but takes chiefly two directions: the one towards the north, and the other towards the south bank of Braydon, forming what are called the north and south channels (see the plan), as low down as a little way below the Middle Cross, where the direction of the north bank of Breydon appears to give a southerly direction to the stream on the north side, and below this the currents are united, and run in one channel; this is, I think, the cause of the sudden increase of depth below the middle cross. The current is sufficient to keep open one deep channel, but insufficient when its force is divided into two: anything, therefore, that will tend to prevent the division of the current in the upper part of the Breydon, and to collect the force into one stream, will tend also to preserve that increase of depth which I have proposed being given at the first by artificial means: care must be taken at the same time to diminish as little as possible the area of Breydon, upon which the scour of the harbour and the bar so much depends.

I would, with the view of effecting these objects, propose, first, that the soil that would be

Walker's Report on making Breydon navigable.

excavated from the part to be deepened be deposited in the places in the north channel, where it will have the greatest tendency to change the direction into the south.

The depth of water in most places, and for a very considerable width towards the upper end of Braydon, is from three to four feet at low water. This may be filled up along the north side to a certain height, say one to two feet above the present level, without any injury to the back-water, as a considerable depth will still be left at low water.

This deposit will not only be useful for the purpose I have described, but will be the cheapest way of disposing of the excavation, as the flats or barges may be floated to the place, and their loads dropped through an aperture in their bottom, as is done at Hull and other places.

Secondly, where the current is to be turned, or the stream narrowed, I would propose carrying out projections or jetties, above high water, formed of the excavated matter, and fronted with gravel, flint, or piling and planking, as may be required. I have marked some of these upon the accompanying plan by the letters C C C, to give an idea of their situation and the object of them.

If the funds of the Commissioners would allow it, a regular contraction of the stream would be preferable to these jetties or groins at the junction of the Breydon with the rivers at each end, and particularly at the lower end above the opening of the Bure, as shown by the lines **D D D** upon the plan, the effect of which would be to remove the shoal, now in the middle of the stream, and to deepen the navigable channel at the same time. The improvement by this would, I think, be much more than equal to the expense.

The general object and tendency of these operations would be to form the navigable channel in the direction of the dotted lines shown upon the plan.

I do not mean to assert, that even with these precautions (unless carried to a greater extent than I should at first think prudent to adopt), a depth of 10 feet will be maintained throughout, without any didelling at all; but I think the quantity and expense of it will be very small, and that this will be still more reduced by the motion of the water disturbing the mud, if steam be occasionally used to drag the vessels, which is, I think, likely to take place.

Thus much for the depth of water, which is the principal impediment to be overcome.

The circuitous course of Breydon will not, on account of distance alone, be considered as rendering it very objectionable. I find that a straight cut across the marshes would shorten the distance about half a mile, but I do not think that any alteration could be made with effect in the Breydon itself, so as to shorten the present navigable channel.

Towards the upper part of the channel, which is marked out by piles, an improvement may be made by moving the piles, beginning at the Middle Cross upwards, a little to the north, as dotted upon the plan. The piles appear now to be driven in the deepest water. Those marks will require additional strength to resist the striking of heavier vessels against them, and more marks may be required at the upper end.

I have looked into the evidence given before the Norwich and Lowestoft Navigation Committee to assist me in appreciating the evil, if any, caused by the Breydon being exposed to the winds, and by the swell of so large a surface of water; but although the difficulties of the passage to Norwich, by way of Yarmouth, were not likely to be overlooked or undervalued on that occasion, I do not find that this is charged as one of them; and if the evil of it has not been felt so as to be important to wherries, it must be less so to sea-borne vessels, and is likely to be still less so, if my anticipations regarding steam are correct. With steam, indeed, by far the best part of the passage to Norwich would generally be the Breydon, from its great width preventing thatresistance to which steam and all other vessels are subject in narrow streams at high velocities.

My inquiries, when in the neighbourhood, led me to conclude that there is occasional delay to wherries getting up the Breydon in very rough weather, particularly when the wind is from the north-west, and from the great length of the lake in that direction, it is reasonable to conclude this to be the case towards the bottom of the lake, as the deep channel does not extend to a great width. If the delay arising from this has been important, it may be prevented, in a great measure, by forming a bank or river wall, of the same form as the banks between the rivers and the marshes along the north side of the navigable channel, from the Lower Cross upward, towards the Middle Cross, in the line W W, so as shown in the plan. This will break the waves, protect the vessels from the wind, and as the ground is dry at low water, it may be formed by the excavation of the Breydon below the bridge without much expense excepting the fronting of it with flint or planking, which may be required. The bank must be so placed as not to exclude nor impede the current of the tidal waters.

Upon the whole, therefore, I feel justified in the opinion I have given, that Breydon may be made navigable for vessels drawing 10 feet water, even taking low water as the standard.

My report as to a lateral cut is requested upon one point only, viz., its effects on the river Bure.

The only way in which the cut could affect the Bure, itself is by abstracting a portion of the tidal water which now supplies that river; but this would be very small, and would soon be compensated by a greater velocity and depth between the sea and the river, so that no sensible effect would be produced in the rise of tide in the Bure.

The passage between the Bure and Yarmouth Bridge is, therefore, the only point in which the interests of the Bure can be affected; it may be supposed that the affect of the cut will, by lessening the current of the water from the Braydon, be to cause shoals and shallow water at the Bure's mouth.

I do not consider this at all a necessary consequence of a cut; because, if the upper end of the Bruydon be left open to receive the waters of the Yare and Waveney (and I hope this is intended), and if the upper end of the cut be formed so as not to draw those waters into it, there will be the same scour in front of the Bure as there now is.

If the opening of the cut were made opposite the Bure, an eddy would be formed there by the meeting of the three currents; but that from the cut would be small, and would be fully compensated by the embankment **D D D**, which I have proposed for narrowing and improving this part.

If therefore a lateral cut be thought desirable in other respects, I do not think that it ought to be opposed on account of its necessary affects upon the navigation of the Bure.

I am, &c.,
J. WALKER.

To Samuel Tolver, Esq.
&c. &c. &c.

APPENDIX B.

NORWICH.

No. 258.
Curtis, on Improving the Navigation of the Yare.

No. 258.

Report of COCKBURN CURTIS, Esq., C.E., *on Improving the Navigation of the River Yare.*

GENTLEMEN,

28, *Charles Street*, *Westminster*, 3*rd March*, 1846.

1. In compliance with a letter from Mr. Staff, of the 21st ult., conveying instructions that I should report to you "my opinion as to the feasibility and best mode under existing circumstances of making and maintaining a navigation for sea-borne vessels between the sea at the port of Great Yarmouth and the city of Norwich, in the county of Norfolk," and from previous communications, believing that specification to apply to vessels of a draught of not less than 10 feet water.

2. I beg leave to report that, from the surveys I have executed of the district, as well as from careful consideration of the subject, I am decidedly of opinion that such a navigation can be both easily made and maintained.

3. Forwarded herewith is a section of the deepest channel at present existing between Norwich and the sea at Yarmouth, the simple inspection of which will prove that the only impediments to the transit of sea-borne vessels are the Knowl, in the Breydon, above Yarmouth Bridge; the shoal at the junction of the Yare and Waveney, called the Burgh Flats; and the shoalness of some portions of the river between the County Asylum and the Foundry Bridge.

4. It will also be seen that the whole of the other parts of the channel are of considerably more than the required depth; and the results of borings and examinations of the soil warrant me in stating that the bed of the river, throughout its whole course, can be deepened to any desirable extent.

5. The most important of the impediments I have alluded to is the Burgh Flats, which has not inaptly been called the bar of the Norwich river. I am of opinion that this shoal has been formed by the abrupt junction of the ebb streams of the Yare and Waveney, which, meeting each other at right angles, diminish the general force of the stream at that part, and thus cause the deposition of the mud which was previously held in suspension.

6. The unfavourable angle at which these rivers separate, together with the shoalness of Burgh Flats, also decreases the impetus of the flood-tide, and deprives it of much of its scouring power.

7. As these causes would occasion the present channel through the Breydon to silt up if it were deepened for sea-borne vessels, I recommend that a new entrance be formed for the River Yare, by cutting a channel through the marshes on either side of it, from the reach below the Brick Yard, at Reedham, towards the Turn-water Jetty, on the Breydon. The general direction of the two cuttings, required for this purpose, will be best understood by reference to the accompanying plan, upon which the corresponding longitudinal and transverse sections are also delineated.

8. In carrying these works into execution, I recommend that the new entrance be opened as soon as there is sufficient depth for the passage of the wherries which now use the navigation; and that a dam be thrown across the old entrance, and small turn-water pilings projected for a short distance into the stream, where the cuttings will cross the old channel.

9. These works being executed, the ebb-streams of the Yare and Waveney will not form a junction until they come nearly parallel to each other on the Breydon, and hence will increase instead of diminishing each other's forces; at the same time, while acting individually in their respective channels, their scouring power, both at flood and ebb, will be materially increased.

10. The shoal above Yarmouth Bridge, called the Knowl, is formed in a similar manner to that at the Burgh Flats, by the abrupt meeting of the ebb streams of the Bure and of the Breydon; and unless some means are taken to alter the direction of those streams, I am afraid that an annual expense must be incurred in dredging that part of the channel. I am, however, inclined to think, that a turn-water jetty on the west side of the Bure would have the effect of confining the ebb-stream of that river, so as to enable it to unite, at a more favourable angle, with that of the Breydon; but if no opposition were offered to the project, and if a union of local interests should at any future time enable the necessary funds to be provided, by far the best course to pursue, both as regards this shoal and the general improvement of the channel; would be to make a new cut at this part through the point of marsh land on the southern side of the present channel. The direction which I should consider the best for such a cut is marked in yellow on the accompanying plan.

11. The shoal portions of the river between the County Asylum and the Foundry Bridge will only require to be dredged, under proper superintendence, a foot or two deeper than they are at present.

12. If the new entrance is cut for the river Yare, I have no apprehension that the channel through the Breydon will have any tendency to silt up; but, on the contrary, I think it will gradually become deeper, because by deepening it at the Knowl and Burgh Flats, the first of the flood and the last of the ebb will be received and discharged at a lower level, and in consequence of being confined to a narrower channel, will act with greater velocity and scouring power. A more free action will also be given to the back-water now shut up in the Norwich and Beccles rivers, and as each foot that is taken off the shoal parts will put in motion 700,000 tons of water, there can be no doubt, that if due attention be paid to preserve for it an uniform and unobstructed passage, so large a body of water will, by its ebb and flow, considerably deepen and improve the channel through which it passes.

13. In furtherance of their intention of establishing a communication for sea-borne vessels from Yarmouth, I think the corporation of Norwich ought immediately to revive their rights and powers of conservancy, and rigorously to exercise them as far as their jurisdiction extends. Some competent person ought also to be deputed annually to examine the deposited plans and notices of railways and other works likely to interfere with the navigation, in order that, when requisite, immediate proceedings may be taken to preserve the river from injury or encroachment.

14. I am not aware at what periods the several ferries were established across the river Yare, but I strongly recommend that an immediate inquiry be instituted to ascertain whether or not they can be set back, as generally they decrease the river, where they are erected, by a third of its average breadth, and the ferry-boats being allowed to lie in front of the jetties still further augments the evil. At Reedham Ferry the navigable channel is thus reduced to 70 feet. The length of these ferry-boats is upwards of 30 feet, and this space might be added to the breadth of the navigable channel simply by compelling their owners to lay them alongside instead of in front of the jetty.

15. As the river, as soon as the dredging is completed, will be accessible to steamers drawing 10 feet water, and eventually, I hope, by subsequent improvement will be deep enough for others of 12 or 13 feet, it is of the utmost importance that no new bridge should be erected at Yarmouth, which has not an opening arch sufficiently wide to admit steamers of that draught of water. Steamers of from 10 to 13 feet water measure from 45 to 50 feet across their paddle-boxes, and to go easily through the

Curtis, on Improving the Navigation of the Yare.

opening arch of a bridge would require a foot or two more on each side; hence an arch, with an opening of from 55 to 60 feet, ought to be obtained through the Haven and Pier Commission, or by petition to the Admiralty.

16. I have made a rough estimate of the probable cost of executing the works, which I have recommended, and find that it will cost about 9000*l.* to open the navigation for sea-borne vessels, but that a further sum of between 6000*l.* and 7000*l.* (making in all between 15,000*l.* and 16,000*l.*) must be expended to make a channel 80 feet wide all the way up to Norwich. Should there, however, be any difficulty in raising this amount, I would recommend that when the new entrance was cut for the river Yare, the Burgh Flats should be dredged a foot at a time, and this, if done in a favourable direction for both the Yare and the Waveney, would, no doubt, increase the scour from those rivers, and thus, in time, would deepen the Channel so much as materially to lessen the expense; but, at any time that I am informed the precise amount which can be conveniently raised for the improvement of the navigation, and receive further instructions to that effect, I shall be happy to prepare a detailed estimate and the necessary plans and directions for its most economical and efficient application.

17. The works which I have previously mentioned, as essential to the formation of a ship navigation, should be carried out immediately, if the necessary funds can be provided; but there are others which would help to complete the navigation, and generally to improve the river, but which, from the expense that would attend their execution, must necessarily be carried out as circumstances may permit. Of these, the most important and first that should be executed, is the removal of several of the sinuosities which at present exist in the course of the river between Burgh Flats and Norwich, as they lengthen the distance for the passage of vessels, and materially impede the flux and reflux of the tide. The parts which I propose to alter may be seen at once on the plan, as the proposed cuttings are marked in yellow.

18. The banks of the river Yare also, throughout its whole course, present a series of encroachments, indentations, and irregularities; its breadth frequently alters 100 feet in 200 or 300 yards, and its average widths, taken at every quarter of a mile, range from 90 to 235 feet. These irregularities in width produce corresponding irregularities in the force of the stream and the depth of the river, and they also check its general momentum and scouring power. I therefore think it would be highly desirable that the encroachments and projections should be removed where practicable, and that the river should, as far as possible, be brought to one uniform width and transverse section.

19. I have already recommended that any new bridge at Yarmouth should be built with an opening arch of from 55 to 60 feet; but in looking forward to the future interests of the proposed navigation, it becomes my duty to solicit attention to the reports of such previous engineers as have recommended that the entire water-way at the bridge and at that part of the haven should be increased.* The breadth of the haven at the bridge at present is only 146 feet, while the average breadth from the pier head upwards is 255 feet, and while at the same time the average breadth of the channel from the bridge to the Breydon is about 330 feet. In addition to the obstruction which this natural contraction presents to the flux and reflux of the tide, the water-way is still further decreased by the rows of piling which support the bridge, and the result is that a quantity of still water is always retained in the Breydon, from its not being able to escape on the ebb before the succeeding flood-tide makes; under ordinary circumstances, the level to which the water falls at low water in the Breydon is about 2 feet 9 inches higher than the low water level of the sea; by the loss of this fall, the marshes on the banks of the Bure, Yare, and Waveney, are kept saturated with water, and the whole of these channels and the haven itself is deprived of the benefit which would result from an uniform and unimpeded action of the tide.

20. The shoalness of the channel in the Breydon, and the irregularities of width and sinuosities in the course of the river Yare, also retain the water above them at a higher level than it would otherwise fall to, and in a similar manner they retard and decrease the momentum of the flood-tide; hence, in proportion as the measures which I have recommended are carried out, the water will fall to a lower level at low water, and the drainage of the marshes adjacent to and above the places, where vertical or lateral obstructions are cleared away, will be correspondingly improved; and indeed, from the general results of the tide observations and levels which I have had taken to ascertain the feasibility of making and maintaining a ship navigation, I am decidedly of opinion that several tracts of marshes, now lying waste for want of drainage, might be embanked and brought under cultivation, if the works which I have previously mentioned were executed.

21. It is stated that apprehensions are entertained by some of the inhabitants of Yarmouth, that deepening the Breydon for sea-borne vessels would, by increasing the scour and the general depth at the haven's mouth, undermine the foundations and endanger the safety of the south pier. Such could only be the case if the entrance to the haven were allowed to retain its present irregular width and transverse section, as that occasions the depth at some parts of the pier to be more than twice the average depth of the centre of the channel; but as I understand that the south pier is shortly to be repaired, and that then it is to be given a more uniform direction, and as the irregularities of width and section to which I advert are also to be reduced, I have no hesitation in stating, that I do not consider the parties alluded to have any just grounds for their apprehensions.

22. In conclusion, I know of no districts where the navigation and drainage are so generally susceptible of improvement as they are in those connected with the port of Yarmouth, and the removal of the obstructions from the bottom of the haven, and the reduction of its channel to a more uniform width and transverse section, although only local works, have been attended with so much benefit to the whole navigation from Norwich to Yarmouth that I cannot but think that, had all the money which was expended in contending for and in fruitless opposition to the Norwich and Lowestoft navigation, been expended in improving the navigation by the way of Yarmouth, both Norwich and Yarmouth would have been considerably more advanced in commercial prosperity than they are at present; and from this mutual dependence of one part of the channel upon the other, I am further of opinion, that if such a desirable co-operation could be effected, by far the best and most judicious plan, as well as that which would be attended with the most benefit to the port of Yarmouth, and to all the parties interested, would be, that they should carry on in concert a well-organized system for the general improvement of the navigation and drainage, not only of the district between Norwich and Yarmouth, but also of those which are dependant upon the rivers Bure and Waveney.

I am, &c.,
COCKBURN CURTIS.

To the Norwich Improvement Navigation Committee.

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* Vide published Reports on Yarmouth Haven,—Rennie's, p. 7; Walker's 1st, p. 13; Walker's 2nd, p. 18.

APPENDIX B.

BECCLES.

No. 259.

Evidence taken on the 1st Nov. 1845.

No. 259.

BECCLES.

Examining Commissioner—JOSEPH HUME, Esq., M.P.

Present:—The Mayor of Beccles (F. W. FARR, Esq.); CAPTAIN GARBEN; CAPTAIN SMYTH; Rev. T. O. LEMAN; Rev. T. FARR; F. S. COSTERTON, Esq.; W. H. CROWFOOT, Esq.; R. BOHUN, Esq.; W. C. SHARPIN, Esq.; H. DAWSON, Esq.; P. STEAD, Esq.; R. MANN, Esq.; and JOHN CHILDS, Esq.

E. C. SHARPIN, Esq., examined.—Beccles navigation is conducted under "An Act for making the river Waveney navigable for ships and other sea-borne vessels from Rosehall Fleet to the mouth of Oulton Dyke, and for making a navigable cut from the said river at Carlton Shares Mill into the said dyke leading to Oulton Broad (1 Wm. IV. c. 50.) The date of the Act is 22nd April, 1831. The objects of that Act, as set forth in the preamble thereof, are, to deepen and make the river navigable for sea-borne vessels, which before it was not. That has been effected as far as Beccles Bridge, and vessels not exceeding 150 tons come here. That was the extent of the tonnage as stated to me by the engineer. I do not think the trade of the river has borne out the expectations of the promoters of the Act. The depth of water, I suppose, is nine feet at Beccles Bridge. Thence it varies to 20 feet in some places at high water.

Mr. CRISP.—The tide rises two feet at Beccles Bridge.

Mr. FARR, the Mayor of Beccles, and Beccles Yarmouth Haven and Pier Commissioner.—The tidal water comes entirely across Breydon—there is no rise by the Lowestoft navigation, as the Mutford Lock prevents the water passing either way.

Mr. SHARPIN.—There is a rise of the tide at the quay at Beccles. The water comes up from Yarmouth and not from Lowestoft, as the Mutford Lock stops it. Our natural navigation is by the Waveney from Yarmouth.

Mr. FARR.—The difference of time between high water at Yarmouth bar and at Beccles Bridge is three hours.

Mr. SHARPIN.—1200*l.* of expense was incurred in obtaining the first Act, including engineers' expenses. The corporation of Beccles advanced to the River Commissioners the sum necessary to defray all their expenses, they having no funds whatever. 1139*l.* 13*s.* 6*d.* was all the money advanced by the corporation. Up to July, 1844, the whole of the dues received under the Act have been 2574*l.*, and none of this has been applied towards improving the navigation, but has all been applied to pay off the expenses of getting the Bill, except what was required to purchase a portion of land by the side of the river. A clause of the Act requires the surplus revenue, after paying the expenses of getting the Bill, to be accumulated till it amounts to 7000*l.*, an event not likely to happen in our lifetime. The tolls have yearly decreased owing to the diminution of the trade; and lately, in order to increase the trade, the tolls were reduced one-half. In July, 1835, 347*l.* was received, and only 172*l.* in July, 1844. This is the surplus from which the 7000*l.* is to be accumulated, but I think ere long we shall have nothing to accumulate except the dividends on the funded stock. The Beccles navigation has no other source of income; but the Haven and Pier Commissioners of Great Yarmouth award us a sum not exceeding 200*l.* yearly.

From the passing of the Yarmouth Act (5 and 6 Wm. IV. c. 49), 1906*l.* has been received from Yarmouth dues by the Beccles Company, of which 200*l.* was received last year. Mr. George Fenn was last year surveyor of the river, is surveyor of turnpike roads, and of the Haddiscoe drainage, but is not an engineer.

Mr. SHARPIN.—The money received from Yarmouth is expended under the superintendence of the Beccles Yarmouth Haven and Pier Commissioner.

Mr. FARR.—When there has been any difficult question, we have sent for Captain Smyth, who is pier-master at Yarmouth. Mr. Cubitt has surveyed the river, and the works, and so has Mr. Edwards. They have given us no report. Mr. Edwards has been consulted only once since the passing of the Act in 1831. The depth of the water in the channel is in a good state all the way until it shoals at the Burgh Flats.

Mr. FARR.—We employ a craft, and dredge out about 17 tons a-day, principally from Shipmeadow Lock, four miles up the river towards Bungay, and sometimes from Beccles Bridge to St. Olave's Bridge. The depth of the water from the Shipmeadow Locks to Beccles bridge is from 4 to 5 feet, and even more than that. The average depth of the water between St. Olave's and Beccles bridges is from 10 to 12 feet. Near Beccles Bridge it is but nine feet, but in other parts of the river 20 feet.

There is no impediment to the navigation for vessels of 9 or 10 feet draught from Yarmouth to Beccles except the solid bridges and the Burgh Flats, where there is a great shoal which Captain Smyth is now dredging to render it navigable for wherries. Sea-borne vessels of 6 or 7 feet draught of water come up from the sea by Lowestoft to Beccles Bridge, and from thence their cargoes are carried up the river in craft of 24 or 25 tons burthen. Were St. Olave's Bridge removed you might bring sea-borne vessels from Yarmouth up to Beccles Bridge, which would be better than going by Lowestoft. The only difficult part from Yarmouth here to deepen is Burgh Flats. If that were deepened, is not aware of any other impediment except St. Olave's Bridge, which I regard as a complete barrier, as it stops the water up and down.

That bridge has been presented as a nuisance by Mr. Stead at the Beccles sessions, but there being a power in the Yarmouth Act to take it down, the magistrates say they have no right to do it. I thought it a public duty when the engineer was down here to inquire about it, and he very kindly furnished me with a plan (which was shown) and estimate for a new bridge. St. Olave's and Beccles bridges were both built by the counties of Norfolk and Suffolk. They are both considered as county bridges. These bridges are the only obstacles to the navigation to the sea, provided Breydon was dredged; but there has always been a feeling of jealousy on the part of the merchants of Yarmouth in regard to vessels going inland beyond Yarmouth Bridge. The Yarmouth Commissioners have thrown every impediment in the way of our having a 44 feet arch at Yarmouth Bridge. The money received for Yarmouth Haven has been laid out by the Beccles Commissioners, between Beccles Bridge and the part which was provided for and ought to have been deepened under

APPENDIX B.

BECCLES.

No. 259.

Evidence taken on the 1st Nov., 1845.

the Act of the 22nd Charles II. From time immemorial the navigation up from Beccles Bridge to the first or Shipmeadow Lock has been entirely under the Haven and Pier Commissioners.

Mr. RICHARD BOHIM, Solicitor of Beccles, stated that he attended here on the part of Mr. William Butcher (the proprietor of the Bungay Navigation.)

Mr JOHN GILES inquired if the Commission extended to take cognizance of private property.

The COMMISSIONER.—Her Majesty's Commission includes all navigable rivers.

JOHN FISHER COSTERTON, Esq., of Yarmouth, and magistrate for Suffolk, stated that the Act of the 22nd Charles II. is for making the Brandon (Little Ouse) and the Waveney navigable.

Under what authority, Mr. Farr, do you consider yourself warranted in expending the 200*l.* you receive from Yarmouth on the navigation between Beccles Bridge and Shipmeadow Lock when others draw the revenue therefrom?

Mr. FARR —I can only say, I examine the bills and pay the money in the same way as my predecessor did. The Yarmouth Haven and Pier Commissioners claim the right of the river to the first locks, commonly called Shipmeadow Locks. They claim as far as the tide flows, which is to that lock where it rises about a foot.

Mr. RICHARD MANN, merchant of Bungay.—It rises two feet at Shipmeadow Locks.

Mr. KNIGHTS —I am a wherryman, and have been on the navigation all my life-time. I know Shipmeadow Lock. I have seen, at good spring tide, a rise of 18 inches, but never more, except from some extraordinary tide, such as we had the 26th January last, when it flowed two feet. The general flow is about one foot. The depth of water from the lock to Beccles Bridge, a distance of four miles, is not more than three or four feet.

Mr. FENN.—Parts only of the money received yearly from the Haven and Pier Fund is applied to the river between St. Olave's and Beccles bridges. We contract for the dredging at 5½*d.* a ton. The stuff raised is ooze, and in many places hard gravel. It is not saleable as a source of additional revenue.

Mr. FARR.—It is laid on the banks of the river. I have often tried to sell it, but could not.

Mr. SHARPIN —There is a minute authorizing the expenditure of the money granted by the Yarmouth Commissioners to improve the Bungay navigation: it is done under the Haven and Pier Act.

The COMMISSIONER.—That is within your jurisdiction, but another Act of parliament gives the jurisdiction to another person from Beccles to Bungay, and he charges tolls for that distance. What business have you to expend money within his jurisdiction?

Mr. SHARPIN.—The magistrates always give an order in session which is laid before, and kept by the Haven and Pier Commissioners. A minute of that appears in the proceedings as kept by the clerk of the peace, (J. H. Borton, Esq., of Bury St. Edmunds). I attend the annual meeting of the Haven and Pier Commissioners at Yarmouth, and present the order, accompanied by an estimate of what is to be done, when it is granted accordingly. The accounts are not published, I have never been applied to for them, or they would be accessible to any person having authority to inspect them. Twelve copies are made for the Commissioners, each of whom has one.

The COMMISSIONER.—Sec. 93 of the Haven and Pier Act requires all the accounts to be open for inspection, and yet there is no copy of the accounts with the clerk.

Mr. COSTERTON.—Those copies are held as private property by the Commissioners.

The COMMISSIONER.—It appears to be a fact that certain monies levied for one purpose by the Haven and Pier Commissioners are expended by them for another, and no account of that expenditure is lodged with the Commissioners at Yarmouth. You have no right to raise money under one Act and spend it for the purpose of another.

Mr. SHARPIN.—The right of the old Act is not saved by the Haven and Pier Act among the rights there mentioned. With respect to the other dues, the collector is paid 10 per cent.; that is done by an order of the Commissioners at a meeting.

The COMMISSIONER.—I have received several letters, among which is one from Mr. J. F. Costerton, magistrate of the county of Suffolk, calling my attention to this navigation, and particularly to the Bungay Navigation Act.

SIR, *Yarmouth, 22nd October*, 1845.

I beg to call your attention to one of the three branches of the navigation which runs into the Yare, called the Waveney, and which it is alleged was made navigable by certain contractors, under an indenture bearing date September 7th, 1672, by virtue of an Act of parliament, 22nd Caroli II., sec. 6, "An Act for making navigable, the rivers commonly called Braadon and Waveney," wherein certain rates were granted, sec. 8, to defray the obligations of making the said river Waveney navigable from Bungay to Beccles.

All the Commissioners appointed by 22nd the of Caroli II. to determine controversies died; and they did not appoint any new Commissioners as provided for by the Act.

Therefore, a new Act of parliament became necessary for appointing Commissioners. So far as the same related to the river Brandon and passed in the 24th Geo. II., but no provision was made for the appointment of Commissioners for the river Waveney in that or any other Act.

Controversies have arisen, and others do now exist, but there are no Commissioners existing to appeal to in the terms of the Act.

It would appear that sums of money have, for a long series of years, been paid towards the maintenance of the river Waveney for six or seven miles above Beccles Bridge, out of the Yarmouth dues upon shipping, when the 22nd Caroli II. provides for the maintaining and keeping in repair the said river from Bungay to Beccles.

There are many other matters connected with this river—namely, the narrow arches of the Beccles and St. Olave's bridges, the heavy tolls of the Bungay navigation, when the expense for keeping it open is so trifling—which call for investigation under your authority as one of the Commissioners for the Tidal Harbours; and for the public good as one of the magistrates for the county of Suffolk, I have considered it my duty to lay the subject before you. I am, &c.,

To Joseph Hume, Esq., M.P., JOHN FISHER COSTERTON.
&c. &c. &c.

Appendix B.

Beccles.

No. 259.

Evidence taken on the 1st Nov., 1845.

Mr. Costerton.—The only authority I can find is the Act which gives power to certain parties to make the navigation from Beccles to Bungay. A certain indenture (a printed copy of which, Mr. Costerton held in his hand), dated September 7th, 1672, gives to the contractors of that day a certain rate on goods passing on the river, for carrying out that navigation. The complaint of all the proprietors of craft in Bungay, is that the present rates are very high, 6*d*. for each lock, making 1*s*. 6*d*. to Bungay. Mr. Ibbotson can show that the collection at the present time is 700 or 800 per cent. more than is necessary.

Mr. Richard Mann.—The tonnage is 18,000 to 19,000 tons a-year; I carry 5000 to 6000 tons upon it; the lockage is 1*s*. 6*d*., which gives a revenue of about 1400*l*. a-year; the freight of grain from Bungay to Yarmouth is 4*s*. a-last, out of which 3*s*. is paid for dues to Mr. William Butcher of Norwich, the alleged proprietor of the navigation. I always paid dues to Mr. Bryant and Mr. Kerrison before Mr. Butcher had it.

It was stated that the expenses in keeping up the Bungay navigation was considered to be about 50*l*. a-year.

Mr. Farr.—The navigation is now in a very bad state.

Mr. Sharpin.—There are bye-laws, but they are not published; they are entered in the book.

Mr. Henry Dowson, examined.—I am a maltster, and live at Geldestone. At Ellingham Mill there is a bridge over that part of the navigation called the Overshot; I have known it to be in such bad repair that a man could not get over it with a ton of goods. Disputes have been as to who should mend it; I once had a dray-load of beer fall in; I complained to Sir Edward Kerrison, the then proprietor, who said he was very sorry for it, which was all the redress I got for it. Mr. Butcher now, as proprietor, receives the tolls; there are two bridges, one crossing the direct navigation and the other the Overshot. I complain that this latter bridge is not kept in proper repair; it is almost impassable; nobody will bring corn over it.

Mr. Mann.—A similar case exists near mine, where the bridge has never been kept up by the proprietor.

Mr. Dowson stated that the proprietor of that navigation, who takes the money, does not repair the bridge over the navigation; and, further, that owing to the negligence of the party who claims to be the proprietor of that navigation, not only do the public pay extravagant rates, but the proprietors of the adjoining lands are being inconvenienced by being flooded.

The Commissioner.—Why do you not sue him, or present it as a nuisance, and have the matter tried.

Mr. Farr.—It has been tried and presented many times. At the time we made the survey, the water was running over 10 inches beyond what it ought; and Mr. Springfield and myself went and opened the gates, but before we were out of sight the men let the gates down again.

Mr. Costerton.—There is a further grievance complained of, as to haulage; and he read the clause directing provision to be made for haulage, and said the works were never completed.

Mr. Mann.—With respect to Beccles Bridge, at the time of high water our craft are constantly stopped at Beccles, because there is not room to get through under the arch. The arch is quite full of water; so that we are sometimes obliged to stop ten days or a fortnight, owing to the water being so high and the arch so low. The largest craft that come through Beccles Bridge are 25 tons, drawing 3 feet 4 inches; that is the most mine draw. The water-way at Beccles Bridge from the curve of the arch depends upon the height of the water. The delay at St. Olave's Bridge is not so great as at Beccles. I have had craft lay four or five days, sometimes longer; however, they generally get through in the flood tide.

Mr. Farr.—At St. Olave's Bridge there are three arches of 18 feet span, and at flood tide the two small arches are under water.

Mr. Stead.—The height of the centre arch is 8 feet 9 inches, and of the side arches 6 feet 9 inches.

Mr. Mann.—The rise of the tide at Beccles Bridge is two feet; the rise at St. Olave's Bridge, I should think, from three to four feet.

Mr. Mann, as a Bungay man.—If a part of Burgh Flats were deepened, and the bridge of St. Olave's and Beccles removed, did not know that it would be of much use. We should have a greater flow upon the flood tide, and the water would be lower upon the ebb.

Mr. Farr.—Heard his watermen complain that they have been delayed from the strength of the current being so great through St. Olave's Bridge; does not know that if that bridge were removed and Burgh Flats deepened, there would be a more convenient navigation than the present one by Lowestoft, as the craft we now employ would then come.

Mr. Mann.—Sea-borne vessels would come to Beccles as they do now by Lowestoft. The navigation would be more complete from the sea by Yarmouth, but I do not think that it would be used, for we then must have a transhipment at Beccles. We carry corn and bring coals, and can get vessels at a cheaper rate at Yarmouth than we could get them up to Beccles; therefore we should prefer taking corn down to Yarmouth, there load our craft with coals, and bring them up to Bungay. We pay no dues between Yarmouth and Shipmeadow; the dues do not begin till we get to Shipmeadow Lock.

Mr. Giles, of Bungay, connected with the navigation and dues on it.—I have found it more profitable to come from London, by the way of Lowestoft, to Beccles, and have the goods carted to Bungay, which can be done at a cheaper rate than by the Bungay navigation. That is a practical fact. It is delivered at Bungay cheaper from Beccles by carting than if it came by the Bungay navigation.

The Commissioner.—What is the opinion of the Beccles people as to the removal of both the St. Olave's and Beccles bridges?

Mr. Crowfoot, of Beccles.—There cannot be a doubt but that a free communication between Beccles and the sea by Yarmouth would be infinitely better than the one now by Lowestoft. Vessels are frequently delayed on Lake Lothing by the week and fortnight together, for which reason merchants do not send their corn by sea-borne vessels.

Mr. John Crisp, Jun.—I am a merchant residing in Beccles. We give a decided preference to Yar-

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Beccles.

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mouth for the great facilities we have there. We give the preference to small craft, because the expense is so trifling. At the same time it would be a great improvement to get Beccles Bridge widened. I do not think a new communication with London by railway will make much difference here, even if the present difficulties are allowed to remain between here and Yarmouth: we have greater facilities of carriage to London than elsewhere. I do not think the railway would carry heavy goods.

Mr. Patrick Stead, merchant of Halesworth, had documents showing that the Norfolk Railroad Company has contracted to carry malt from Norwich to London for 13*s.* 6*d.* a-last. They have also agreed with another party, if they would give them a certain quantity of tonnage in the course of the year, that the price shall be 1*s.* 1*d.* a-quarter. There are ten quarters to the last. The distance from Beccles to London is about the same as from Norwich. That will effect this port very materially, because they would get malt from here to London in large quantities at 1*s.* 1*d.*, or in small quantities at 1*s.* 3*d.* per quarter.

Mr. Mann.—The expense of transhipment from here at Yarmouth is 10*s.* a-last. A little more if below the bridge, because there is a lighterage.

Mr. Stead.—The freight from Norwich to London is 13*s.* 6*d.* a-last; the captain's farthings are 2¼*d.* a-last; metage 3*s.* 8¼*d.* a-last; backing and Lord Mayor's dues 8*d.*; wharfage 10*d.*; and cartage 5*s.* a-last; insurance 2*s.* 11*d.*; making a total 1*l.* 6*s.* 10*d.* for a last of corn from Norwich to London by sea instead of 10*s.* 10*d.* by railway.

If greater facilities were given to load at Norwich or here in sea-borne vessels, they would be able to compete with the railway. The present mode of loading is very injurious to the malt; the transhipment exposes it to the action of the air. There cannot be two opinions as to the benefit that would accrue from removing the present obstructions to the navigation. If they continue as they are, I think the railway will carry a great deal of the traffic; indeed, for malt going to London, the whole. My thorough belief is, that the effect of railways will be to do away with the small ports, and make Yarmouth, Ipswich, and Lynn, the three ports for Norfolk and Suffolk: and that those who do not go to those ports must send their corn to London by rail; and that coals will be put on the rail at Yarmouth. It would cost me at Halesworth 1*s.* 11*d.* more to bring coals by sea by way of Southwould than by Yarmouth; so that that will completely annihilate the trade in coals both from Lowestoft and Southwould. I attended Captain Hamilton Fulton, who assisted Mr. Rennie to make his survey. Captain Fulton stopped at Beccles Bridge, and told me it was one of the greatest evils Yarmouth harbour had; it prevented the water flowing up and down freely as it ought. It had also a great effect in flooding the marshes and the town itself. I have had my own malt-houses at Beccles flooded to a great extent. Captain Fulton said that if that bridge were removed and one of larger span made, it would add much to the depth of Yarmouth Haven, and greatly drain the marshes round here, as well as at St. Olave's. I applied once to the Norwich magistrates, in the case of a flood, to open the flood gates at Mutford Lock. I had a letter from Mr. Edwards, dated 19th February, 1833, in which he proposed to let it out, only that it would undermine the lock. If they had a compensation gate there, it would very much relieve the whole, and prevent the flooding of the neighbouring lands.

Mr. Mann.—Between Beccles Bridge and the Mutford lock the navigation is in good order.

Mr. Farr.—From Beccles to St. Olave's Bridge there is double and treble the depth of water; you have 14 or 16 feet.

Mr. Mann.—There is plenty of water till you come to Burgh Flats.

(To Captain Smyth.)—The principal difficulty on Burgh Flats as to shallow water has been near the mouth of the Waveney, at the junction of the two rivers; about three-quarters of a mile. The only difficulty is the mere question of expense. Below that, in the Breydon, there is sufficient depth for craft of 4½ to 5 feet water and the part beyond that is 7 feet.

Mr. Mann.—We have grounded at Burgh Flats with 3 feet water.

Captain Smyth.—The expense of deepening the channel to 9 feet through them would cost about 3,000*l.* There would be about 2½ miles to deepen. We are now deepening the Waveney to the mouth of the Norwich river. The impediments to the navigation of sea-borne vessels drawing 9 feet to St. Olave's Bridge might be removed for about 3000*l.*

Mr. Farr.—I think it would be beneficial to employ a portion of the funds of the Haven and Pier Commission to assist in doing this; but every farthing that we do not expend here, is, if required, refunded to the Yarmouth fund. I go on the principle that if you are to benefit by the tide, and make back-water, you must begin at that place.

Mr. Dowson.—I think there is one impediment which has been overlooked, that is the frost in winter. In the Norwich river, it is said, there is a rise of 18 or 20 inches, which prevents the river being frozen over. In this river we should want to be free from that. In case of any improvement, the land-owners should take care to keep the stream lessened down the river, turning it into the centre. If you remove the shallow waters at Braydon Flats, you must then remove another obstacle; for unless the bridge at Yarmouth be removed, it will be of no use doing anything elsewhere. You want nature to do the scouring, and she will do that if the bridge be removed.

Mr. Farr.—So great an obstruction is the Yarmouth Bridge, that I think you will not find a dissent voice about it. All are agreed that Yarmouth Bridge is an impediment to making Beccles a port.

Mr. P. Stead said, that it was thought by some persons, that if the water were let in by removing these obstructions, the marshes would be overflown, and the marshes flooded; but he knew a case that would meet such objections. It was the case of New Haven harbour, in Sussex, where the river to Lewes had been so much improved, that where 13 feet water formerly was they had now 20 feet; and where they could only get boats up, loaded vessels now went up with ease; and the landed proprietors now pay half the expense of deepening the river, because it enables them to drain their lands. The lands which used only to grow rushes, could now graze cattle for nine months in the year.

Captain Smyth.—From Yarmouth Bridge to St. Olave's the distance is about 9 or 10 miles; thence to Beccles, 16 miles and to the lock at Shipmeadow, 4 more.

Mr. Mann.—In the 30 miles of tidal water, the rise is only from 1 to 2 feet.

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Evidence taken on the 1st Nov., 1845.

MR. FARR.—This is the working plan of a bridge which we propose making at Beccles [*produced*], giving a public carriage-way 15 feet 6 inches, and a public foot-path 4 feet 6 inches, together with an arch of 60 feet span, and it could be constructed for 3000*l.*

MR. FARR.—I have always urged the removal of these obstacles to the navigation every time I have met the Commissioners at Yarmouth, I have mentioned the subject there.

COMMISSIONER.—Have you ever made a regular motion, entered in the minutes, to promote that object?—I have made motions at the haven and pier meetings, but was always negatived.

Have you given notice of motion at one meeting and brought forward the subject at another meeting, that the matter might be discussed, and what has been the result?—I have never given notice of it, but I have brought the subject before the Commissioners, and it was rejected for want of funds.

Have they not the application of 12,000*l.* a-year?—Now they have.

Having heard that 3000*l.* would do it, do you not think it ought to be done?—Yes, and I will bring it forward at the next meeting. Owing to the improvements that have already been made, their receipts have arisen from 7000*l.* to 12,000*l.*

Have not those benefits arisen from dredging and clearing the water-way—Most assuredly, and if those advantages are obtained and carried on we may double them.

Have you any map of the navigation?—None; there never has been one in existence.

[The Court adjourned.]

No. 260.
Correspondence relative to the harbour.

No. 260.

Report of MR. CUBITT, C. E., *on the River Waveney.*

London, 1*st December*, 1827.

HAVING been instructed to survey and report upon that part of the River Waveney, extending from Oulton Dyke's Mouth to Beccles Bridge, with a view of making the same navigable for sea-borne vessels, and to estimate the expense of such measure, if carried into effect, I now beg leave to state, that in conformity with those instructions, I have taken a view and survey of the river as relates particularly to its width and depth; and, through the assistance of Mr. Barnes, of Lowestoft, Land Surveyor, who very kindly furnished me with his extensive and accurate surveys of the lands along that part of the river, I have been enabled to construct a correct map of its course from Beccles to Oulton Dyke; and in order to show more clearly its connexion with the sea, by means of the Norwich and Lowestoft Ship Navigation now in progress, I have continued the map to the intended new entrance at Lake Lothing; thus giving at one view the whole line of navigation from Beccles to the sea, and which map I have annexed to this report.

Although my instructions limit me to the consideration of that part of the river only, between Oulton Dyke's Mouth and Beccles Bridge, and to which, as far as expense goes, I shall strictly confine myself, yet I consider the subject of so much importance to the neighbourhood in general, and to the town of Beccles in particular, both as it regards its commercial prosperity, and the improvement that might be made to its extensive marsh property, lying along the river, that I shall take the liberty of pointing out, in an Appendix hereto, what appears to me the most complete plan for obtaining the best ultimate results; and of which the part I have now to estimate, would form, as it were, a beginning which could be further acted upon as time might require, or the best means for carrying into effect be ascertained.

So soon as that part of the Norwich and Lowestoft Navigation, between the sea and the river Waveney be completed, Beccles will, in effect, become a port, without anything being done, for a certain description of sea-borne vessels, and what are called Billy-Boys, which draw from 5 to 6 feet water, and navigate the eastern coast between London and the large trading towns in Yorkshire, as Leeds, Wakefield, and many others; and in order to make it accessible to vessels of 100 to 150 tons, the river will require deepening for only about two miles at its upper end near Beccles Bridge, to obtain 10 feet summer depth of water, all the way from Oulton Dyke's Mouth to the said bridge; as will be seen on reference to the map, where the widths and depths, at various places, are marked in the form of fractions, the numerator denoting the width, and the denominator the depth, both in feet; from which it will be seen, that up to Stanley Staithe, or thereabouts, the river has at present a width of from 70 to 100 feet, and a depth of from 10 to 14 feet, being amply sufficient for vessels of 100 to 120 tons register, without any alteration; above Stanley Staithe the depth begins gradually to decrease from 10 and 11 to 5 and 6 feet at Beccles Bridge, and continues at that average depth all along the town above the bridge.

The general dimensions of the river from Beccles Bridge to Oulton Dyke's Mouth, are as follows:—length, 7 miles, 5½ furlongs; average width, from 19 cross sections, 86 feet; average depth, taken from about 100 soundings, 10½ feet.

In order to make the river of sufficient depth up to Beccles Bridge, it will require to be dredged 1½ foot deeper, on the average, from Stanley Staithe to Wood Corner; and 3 feet from thence to Beccles Bridge; this, at an average width of 12 yards for the bottom, would amount to a total of 25,410 cube yards; which, including every expense of the hire of engines and barges, coals and workmen on board, and removal and unloading the soil, could not exceed 1*s.* 6*d.* per yard cube, under extraordinary circumstances; but this being a small work, it will cost more in proportion than a larger one: therefore, taking it at the above statement, the whole expense of making the river, from Beccles Bridge to Oulton Dyke's Mouth, navigable for sea-borne vessels not exceeding 10 feet draught of water, will not exceed the sum of 1,905*l.* 15*s.*, and the soil arising might be applied with advantage to raising the land, and forming an embankment all along the town lands belonging to the corporation, with a view to their being ultimately drained; and which, is well and effectually done, would much increase the value of the land.

Having thus stated that the probable expense of making the River Waveney navigable for sea-borne vessels, from Oulton Dyke's Mouth to Beccles Bridge, will not exceed 1,905*l.* 15*s.*, I conceive my instructions are fulfilled; but as the survey necessary to be made for ascertaining this fact was such as will enable me to go into the cost of more extended operations, should it be requisite at any future time so to do, I shall be ready at all times to hand any further information as to the general probable

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expense of prosecuting this measure, and in any of the various plans, or to any extent, that may be thought desirable, without going into a further survey.

W. CUBITT.

NOTE.

Although the instructions for my report and estimate went only to that part of the river between Beccles Bridge and Oulton Dyke's Mouth, yet the subject appears to me of so much importance to Beccles, which must necessarily, on the opening of the new harbour at Lowestoft, become the head of the ship navigation, that I trust in being excused for extending my remarks, by way of Appendix, as to what would be the most complete mode of obtaining all the advantages by art, towards which nature has already done so much; for, although the work and expenditure, pointed out in the above report and estimate, would go very far towards accomplishing the desired end, and would, as far as it goes, form a proper beginning to the ultimate object, yet it would fall far short of what, in my opinion, should be done, to make Beccles a port, whether considered with reference to any future extension of the inland navigation of the Waveney above Beccles or not; but from which this should be considered as a distinct question, as the other would naturally follow in process of time, and according to the common course of similar events, for the purpose of taking off the landed produce, and supplying coals and other articles to Diss, Eye, and the surrounding country; but to the town, neighbourhood, and interests of Beccles, it is of the first importance to secure to themselves the benefits attached to the measure of making it a shipping place, and obtaining a direct navigation to the sea.

On reference to the map it will be seen, that the distance from Beccles Bridge to Oulton Broad would be very much shortened by making a cut from Carlton Share Mill to Oulton Dyke, near the Broad, along the parish boundary between Carlton and Oulton; by this means a vessel from Beccles would be in Oulton Broad before it would have reached the Dyke's Mouth, by pursuing the course of the river; and this cut, of about half-a-mile in length, would save more two miles of navigation, and that of the most difficult kind, in the whole distance between Beccles and the sea.

By means of this cut the navigable distance from Beccles Bridge to the shiplock at Mutford Bridge, would be about 8½ miles, and from thence into the sea at Lowestoft 1¾ mile more, making a total of but 10 miles, or thereabouts, from Beccles Bridge to the sea, for sea-borne vessels, without either delay or transhipment; an improvement over the present distance, time, and mode of doing business, that, I may venture to say, is without parallel in the history of inland navigation.

The passage of vessels from Beccles to the sea, and *vice versâ*, might be effected in foul winds or calms, either by steam-tugs, or by a towing-path along the entire south side of the river from Beccles to Oulton Broad; and this latter would afford the best means towards effectually draining and improving all the marsh lands, and the borders of the uplands, in the parishes of Beccles, Worlingham, North Cove, Barnby, and Carlton Colville, that could possibly be devised; for, by means of a towing-path embankment next the river, and a good land-spring drain along the foot of the uplands, the entire level might be drained, either by sluicing into the tideway of Lake Lothing, or by being milled into Oulton Broad, or both; a measure that would most materially improve all the low lands on the south side of the Waveney between Beccles and the sea.

But to return to the navigation of Beccles. Instead of stopping the vessels at Beccles Bridge, the best way would be to make the river along the town deep enough to have vessels lie alongside the quays, and wide enough for the purposes of a dock or harbour. This could be effected by the simple and easy means of converting Beccles Bridge into a draw or swing bridge, or by removing the bridge higher up the river, or both, as occasion might require.

W. CUBITT.

To the Portreeve and Corporation of Beccles.

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Correspondence relative to the Harbour.

No. 261.

To the Justices of the Peace in Beccles Quarter Sessions.

GENTLEMEN,

By the 12th Geo. III., c. 14 (1772), an Act of Parliament was passed for the raising a fund by an impost of a halfpenny per ton, or last, on all imports (fish excepted) into Yarmouth harbour, which impost is directed to be paid unto such person or persons, by "the Justices of the Peace at the Quarter Sessions holden at Beccles, or Lowestoft, in and for the county of Suffolk, shall be yearly appointed to receive the same, to be applied *for and towards the cleaning and deepening the said river Waveney*, in such manner as the Justices of the Peace for the said county of Suffolk, at the Quarter Sessions holden as aforesaid, shall order and direct; also for and towards defraying the expense of procuring and carrying into execution a *Commission of Sewers* for improving the navigation of the said river Waveney, and for removing all such impediments and annoyances as shall be found to be dangerous and hurtful thereunto."

The same is directed to be paid at the annual meeting of the Haven and Pier Commissioners at Yarmouth, where it is to be accounted for.

By the printed Report of Mr. Cubitt, it appears that the river Waveney is now navigable up to the town of Beccles for Humber keels, and up to within two miles of Beccles Bridge for sea-borne ships drawing 10 feet water; and that the navigation up to the bridge might be completed for ships at an expense of 1905*l.* 15*s.*

It is also enacted by the said Act that, "in case the money allotted to the county of Suffolk shall be more than sufficient for the purposes to which the same is appropriated as aforesaid, the Commissioners of Yarmouth Haven are authorized from time to time, to order such part of the said surplus as shall be necessary for the purpose aforesaid, to be laid out and employed for such public purposes within the county of Suffolk as shall seem most meet and expedient, anything herein to the contrary notwithstanding."

For this and other improvements, pointed out by Mr. Cubitt, an Act is intended to be applied for, for improving the river Waveney, beginning at Rosehall Flat and ending at the junction of Oulton Dyke, where the Norwich Navigation joins the Waveney, instead of its ending at St. Olave's Bridge; to include also the free and uninterrupted junction with Yarmouth—a subject of as deep importance to Beccles as it must be to Yarmouth; and upon this part of the river there is 12 to 18 feet water, which ought to be mutually free, to Beccles as well as to the Norwich Navigation Company.

It is understood that the duties for the trade of Yarmouth, which is allotted for Suffolk, have for a long series of years been accumulating, until now they amount to more than 1700*l.* Not being able to

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perceive what public profit or advantage can arise from holding this money so long in hand, I humbly submit the great benefit that must necessarily arise to the trade of the river, by deepening it in compliance with the Act; this money might be "applied for and towards cleaning and deepening the said river Waveney, in such manner as the Justices of the Peace for the said county of Suffolk, at the Quarter Sessions, shall order and direct." Should this surplus money not be so applied, will it not be considered, as the Act expresses, "more than sufficient for the purposes to which the same is appropriated?" and the Commissioners of the Haven and Pier at Yarmouth "may lawfully, from time to time, order such part of the said surplus, as shall be necessary for the purposes aforesaid, to be laid out for such public purposes within the county of Suffolk as shall seem most meet and expedient?"

If the last construction be put upon the question, on what ground of justice (when so large an amount is in hand, equal to make Beccles a port up to its bridge) can an application be made for further imposts upon trade for the deepening and improving the navigation of the Waveney, the object of the present Act.

The Corporation of Norwich received 1½*d.* per ton, or last, upon imports at Yarmouth, which, it is understood, has been all laid out in deepening the Norwich river, except 200*l.*; it is also said that there is, out of a similar fund, no less than 1900*l.* in the hands of the Treasurer of the river Bure, and 1500*l.* in the hands of the Corporation of Yarmouth for their bridge, whilst the body of Commissioners at Yarmouth have deemed it expedient to borrow larger sums at heavy interest; therefore, if the river money be not applied now for the improvement of the rivers, will it not very soon be wanted to pay the general debt of the harbour? If the money now in hand be laid out towards improving the navigation of the Waveney, is it not possible that an agreement might be made with the Norwich Navigation Company for them to complete, at their expense, the remainder of the said Navigation up to Beccles town, make the cut into Oulton Broad, as proposed by Mr. Cubitt, and to alter Beccles Bridge? If it be deemed more desirable that the above should be completed at the expense of the public, the Norwich Navigation ought to consent to charge only a proportion of their dues upon the Beccles trade, when it is considered that they do not make the cut, deepen the river, alter the bridges, towards Beccles, in the same manner as they intend to do towards Norwich. It is most respectfully submitted, that an agreement of this nature, upon equitable terms, alike to all other navigations of the kind, ought to be adjusted; as it appears the very first and most essential preliminary to any application to be made to Parliament, as well as agreeing the river from Oulton Dyke to St. Olave's Bridge be mutually free to Beccles as it is to Norwich for sea-borne ships, was, that the Beccles trade should, at any future period, be conveyed by sea-borne ships, either through Lowestoft or through Yarmouth, on paying the dues only of the port through which it may pass, as the state of the wind, dues of either port, or other advantages, prove favourable.

In submitting, most respectfully, the foregoing observations, I hope that the Bench may make an immediate order for the deepening of the river, in such manner as they may deem most expedient.

I have, &c.,

Patrick Stead.

No. 262

Extract from letter on Thetford and Brandon Navigation

No. 262.

Thetford and Brandon Navigation.

(Extract from a Letter to the Assistant Secretary to the Tidal Harbours Commission.)

Thetford, March, 23, 1846.

Sir,

The navigation between Thetford and Brandon is under the management of the town council of this borough. It is in a good state of repair, and out of debt; but the charges in the shape of talls are very oppressive—say, for the 6 miles, 10*d.* per ton for coals; 1*s.* per last on corn; and 1*s.* per ton on goods. There are five staunches or sluices.

The whole length of the navigation, under the management of the Thetford Town Council, is 12¾ miles long, to a place called Whitehouse, about six miles below Brandon. The additional charge for this last six miles is 5*d.* per ton on coals; 6*d.* per last on corn, and 6*d.* per ton on goods. The fall from Thetford to Whitehouse is 19 feet.

Lowestoft.

No. 263.

Evidence taken on the 4th Nov., 1845.

No. 263.

LOWESTOFT.

Examining Commissioner—Joseph Hume, Esq., M.P.

Among the gentlemen present were—Sir Thos. Gooch, Bt., Capt. Leggatt, the Rev. F. Cunningham, Messrs. G. F. Gowing, J. Lincoln, W. Cleveland, J. Cleveland, W. Youngman, J. Hickling, W. Barnard, J. Prentice, H. Hodges, S. S. Brown, J. Jex Woods, Edm. Norton, T. Preston, J. Day, R. Johnson, J. Thurtell, T. Pratt, R. Morris, all the Pilots, and some of the inhabitants of the town of all classes.

Commissioner.—I wish to know what the inland navigation at Lowestoft was before the Act of 1827 passed?

Mr. George S. Gowing.—I am agent to Lloyd's. Goods used to be brought in waggons from Yarmouth; coals were sometimes brought to the beach. Small wherries used frequently to bring up coals and goods from Yarmouth by the river Waveney, but the expense prevented their general use, and the detention which occurred in frosty weather rendered the navigation useless; and at times coals rose from 40*s.* to 3*l.* or 4*l.* a chaldron.

Since the Act of 1827 for the opening of Lowestoft Harbour, we have had the price of coals much reduced, and also the exportation and importation of goods and salt, and other articles, with the export of herrings (dried) to London. Since the sluice-gates have been injured, the harbour has been in disrepute, and, in consequence, its harbour has silted up. Improvements might be made by the extension of the pier; had found the harbour available from its opening in 1832, until the bar became bad.

After the harbour was opened for several years, there was a sufficient depth of water for the trade of the port. There was from 10 to 11 feet water: it decreased from 1839 when the sluice-gates began to get useless. They got out of repair in consequence of the worm destroying them for want of having been coppered; the income of the harbour was not sufficient to keep them in good order.

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No. 263.

Evidence taken on the 4th Nov., 1845.

The expectations which were entertained at the passing of the Act would have been thoroughly realized if the works had been efficiently made. The quays and embankments not being properly secured, were washed away. If they had been efficient, I do not doubt that the income would have been ten times what it is.

It had occasionally (never altogether) been silted up so that vessels could not go out. The soil, which was left in a loose state, fell in and filled up the middle.

Lake Lothing was dredged from the Sea Lock to Mutford Lock by a steam dredge, but that was not continued, as the harbour was neglected by its original projectors. It continued in an efficient state for eight or nine years after its opening.

[*Mr. Gowing then handed in a list of vessels which had been saved to the owners and underwriters from* 1832 *to* 1845 *inclusive, from which it appeared that the total value of property saved during that period, by the facilities afforded by Lowestoft Harbour, amounted to* 131,317*l.* 16*s., these were cases which had fallen under Mr. Gowing's observation as agent to Lloyd's.*]

Mr. Richard Barnes, Land Surveyor—had lived 40 years at Lowestoft. When the harbour was first opened, vessels drawing 10 feet water used to come in. The greatest difference in the level of the water on either side of Mutford Lock was eight feet.

Mr. Hodges, Engineer to the Harbour.—The average range of spring and neap tides is six feet on the bar. The greatest range ever known was 14 feet, and it occurred during a north-west gale.

Mr. Gowing.—The tide was governed greatly by the wind.

Mr. Hodges.—The greatest range of tides was seven feet in land-floods on the Oulton Broad side of Mutford Lock; and he had known the water on Lake Lothing side four feet higher than on the other.

Mr. Barnes.—If that lock did not exist, Lowestoft Harbour would have the benefit of the scour from the Waveney at times to a great extent; and during other times the Waveney might have the advantage of four feet water from the sea, through the lakes.

Mr. Hodges.—The time of high water at the pier here, at the full and change, is half-past nine o'clock, and is within a few minutes of the same time at Mutford Lock; but it is four hours later there in the Oulton Broad. The tide takes, in going by the Waveney from Yarmouth to Mutford Lock, four hours, or four hours and a-half.

When the land in the country is flooded on the west by the freshes of the Waveney, we are not allowed to open the gates to let out the water into Lake Lothing. We are allowed only to open them enough to admit a vessel; merely a lock full at a time.

Although the opening of that lock would undoubtedly be to the advantage of the lands west of the lock, and would equally benefit the harbour of Lowestoft, the doing it is especially prohibited by the Yarmouth and Lowestoft Navigation Act.

Mr. Barnes.—The level of the mud in Lake Lothing used to be much lower than it is now; it has been silting up.

Mr. John Woods resided at Mutford Bridge—Before 1827 the average depth of Lake Lothing was about four feet. When the harbour was first opened it was better than it is now; it had nine feet water, and vessels of that draft came in. The channel at that time was in the centre of the lake, nearly equal in width to the slope from high to low water; we always considered we had the best channel in the centre to which, from the sides, the water gradually deepened, so that vessels came up drawing nine feet water. The present depth is only seven feet or 7½ feet in the dredged part; the lake has generally silted up four feet. Prior to this last dredging we had great difficulty in getting up vessels drawing six feet water

Mr. Gowing.—We had a large piece of land left for a quay to the westward of the lock on both the north and south sides of Lake Lothing. This, instead of being piled off, was left open, and the tide remaining stationary, at high water, for some 10 or 15 minutes, the silt which it brought up was deposited there.

Mr. Barnes.—Sluicing was carried on for six or seven years after the harbour was made, by means of a lock which has been recently removed.

Mr. Gowing.—It was a very strong sluice gate. Usually once or twice between the spring tides, if they could get four feet of back water they used to sluice the bar when it was bad; and they would then get nine or ten feet water over it. If they had sufficient water over the bar, they were not anxious to sluice.

Mr. Thomas Lane.—The sluicing scoured away almost all the stuff inside the pier, and a great quantity of sand was sent out to sea, that threw the bar further out and gave the outlet more spread. I believe at first the best outlet was to the north, and that threw the silt clear outside of the bar.

The sluicing rather created a bar than otherwise; there was so much stuff removed that it hardly went out to low-water mark. The bar is now considerably nearer than it then was. It never was dry, but I have seen boys walk across it since the sluicing was discontinued, and some times before.

Mr. Hodges.—During last summer, the depth of water had varied during average tides from nine to six feet over the bar. Occasionally it has been 10 feet water over the bar: that was two feet above the zero level taken at the lock. The bottom of Lake Lothing is now two feet higher than when the lock was opened.

Mr. Lane.—From the sluices not being in order, a great quantity of water used to escape through before they sluiced.

Mr. Gowing.—The general opinion is that, from the harbour having been neglected, it is deteriorated, and the trade has been reduced. All that the Exchequer Loan Commissioners did while they had the navigation, was to pay an engineer for doing nothing. Mr. Edwards, who was the engineer, is not here now.

—— **Hickling**, Esq., Solicitor.—The Exchequer Loan Commissioners sold the harbour for 4935*l.* Six individuals purchased it in September 7, 1843.

Mr. Gowing.—They have materially benefited it. They fitted up the south pier to prevent the silt coming in, but not sufficiently.

Mr. Hickling.—The present Company have put it in repair again.

APPENDIX B.

LOWESTOFT.

No. 263.

Evidence taken on the 4th Nov., 1845.

Mr. **JAMES CLEVELAND.**—It was sold for 12,500*l*., to Mr. Peto, in October, 1844, after having been held by the first purchasers, of whom I was one, for two years. In those two years we expended about 2,000*l*., in addition to the receipts.

Mr. **HODGES.**—Since the harbour has been under Mr. Peto, we have, since October, 1844, repaired the lock, and dredged such portion of Lake Lothing as required it, so that we have 10 feet at ordinary high water in the channel, which is about 70 feet wide at the bottom. The channel is buoyed off. The dredging to Oulton Dyke, and the New Cut, is now going on, and when that is dredged, there will be 10 feet from the New Cut to the Mutford Lock. Beyond Oulton Dyke there is plenty of water to Beccles. I believe there would be no impediment to a vessel of 200 tons getting up to Norwich but a little shoal water, which is close up to it, at Thorpe, where there is only eight feet of water.

Mr. **W. V. BARNARD**, the late agent to the London, Lowestoft, Beccles, and Norwich Navigation Company.—I have known vessels, for want of water, to be three weeks going up to, or coming down from Beccles before there was dredging, even with a tug. I have also known vessels to lie in the harbour a week, I may say, a fortnight, unable to get out on account of an easterly wind or want of water at the bar: they were London traders, vessels drawing seven or eight feet water.

Mr. **JOHN J. WOODS.**—I have had coal-ships lie 10 days in the roads before they could get in. They do not lie long in going out, because we partly load them before going to sea, and partly at sea. They have lain sometimes detained eight or ten days for want of water over the bar. We frequently put part of the cargo on board of vessels of 100 tons when out at sea, for want of water on the bar. If they could get in or out laden, I should not run that risk.

JAMES BAINES SWAIN has been a harbour pilot for 13 or 14 years; a year or two after the opening of the harbour, has come into the harbour in vessels drawing 10 and 11 feet water; has seen the bar 30 or 40 yards beyond, and at other times 10 yards within, the pier. The sluicing used to carry the bar further out, and lay it flatter; a southerly wind filled the harbour up, but a north-west wind opened it. After the flood in the offing makes up for an hour and a-half, an eddy runs the other way, which occasions the bad bar; it then takes a sweep, setting outwards to the east, and coming in from the west. The inner shoal is about one-third of a mile from the entrance of the harbour; there have been great changes in the depth of water upon it, sometimes vessels drawing 10 feet water ground upon it, and at other times vessels drawing 13 feet pass over easily: it changes every week. The old Stamford Channel had been for some time disused, but within the last year or two the new Stamford Channel had opened out, and there were now five fathoms of water in it; and the Newcome and Holm Sands have both greatly decreased: all the sands are constantly changing.

Mr. **HODGES** produced a map of the coast, and stated that the extreme point of Lowestoft Ness had, since 1825, gained 132 yards on the sea, but that about 32 yards of the beach on the south side had been carried away by the sea during that period.

Mr. **SWAIN** stated, that in consequence of the changes in the outer sands, there was much more difficulty than there used to be in getting vessels into the harbour; there had been less water in the channel into the harbour during the last six months than there had ever been before. Pakefield Gat is very bad; there is not more than 15 feet water in the heart of the channel; had known, during the last 7 or 8 years, 4 fathoms or 4½ fathoms in the same place; had seen, between Lowestoft Point and Caister Point, at the entrance of the Cockle, from 300 to 500 sail in Abraham's Bosom (Lowestoft South Roads); had seen as many as 200 sail wind bound, waiting to go to the northward. At present the Inner Newcombe Sand is increasing; the Pakefield Channel is silting up. The Barnard Sand is improving; there is as much water now on it as in the channel; the Inner Newcombe was no impediment to entering Lowestoft Harbour; there were 3½ fathoms at low-water. Between the Inner Newcombe and the shore, the shore was becoming steeper; a south-south-west wind was the worst to come into the harbour with, because, when he had a lee tide or wind, the piers did not extend far enough out; and until that was done it was his opinion there would never be a good entrance: he thought they ought to be carried out across the flat into three fathoms water; the bottom there was a firm clay, and good holding ground. Spring flood and ebb tides run about 2½ knots; the flood strikes off from the point, and takes a sweep to the south and south-west, until it sets into the land about west-south-west; the first hour and a-half of flood comes to Lowestoft Harbour, the rest thrown off by the Ness, and comes in from the westward; there were a great many wrecks in the neighbourhood, chiefly from the vessels mistaking the buoys and lights; the holding ground was excellent.

Mr. **GOWING** (Lloyd's) recollected, in 1837, that there were 70 sail of vessels on shore at one time; had known from 16 to 20 vessels take refuge in the harbour when it was in good order.

Mr. **SWAIN** had been in a vessel drawing 10 feet water to Mutford Lock. He did not think any improvement could be made in the buoys or lights; the changes in the channel were well attended to, and all pilots were examined under the Trinity Board; vessels coming in with a steam-tug do not pay pilotage.

Mr. **GOWING** did not think the present Company were bound to keep the harbour open; but he believed the Exchequer Loan Commissioners had parted with it at a cheap rate, with the view of its being kept open.

A statement was then read, showing that, in 1843, 591 vessels arrived and 566 sailed, making a tonnage of 28,000 tons. In 1844 there were 591 vessels arrived and 556 sailed, making a tonnage of 28,000 tons. And up to July, 1845, the arrivals were 402, the departures 389; the tonnage, 23,601; the annual receipts for 1842 were 1390*l*.; in 1843, 1189*l*. Mr. Gowing stated that the tonnage of each of these vessels varied from 50 to 120 tons; vessels of 200 and 240 tons had come in, but not with full cargoes; they were lightened in the roads before they came in.

Mr. **SWAIN** had come in about 8 years ago with a vessel drawing 11 feet water. During the last fortnight the harbour had been in a better state than it had been for some time past; there was now about 9½ feet on the bar.

Mr. **HODGES** produced the plan for forming a square close harbour, with an entrance at the south-east angle as proposed by the present proprietors; further explained that the northern pier was to be 260 feet north, and the southern pier 300 feet south of the present entrance: they were to be run out for 1000 feet into 14 or 15 feet water; and the northern pier was to turn at a right angle to the southward.

Mr. **SWAIN** was of opinion that if such a harbour was formed, its entrance would be kept open, and it would be available at all times.

No. 264.

W. CUBITT, Esq., C. E., *to the Committee appointed for taking into consideration the best means of opening a Navigable communication from Norwich to the Sea, capable of admitting the passage of Sea-borne Vessels not exceeding* 100 *tons burden, and Eight Feet draught of Water.*

Cubitt, on a Navigable communication from Norwich to the Sea.

GENTLEMEN, *Ipswich*, 17*th July*, 1820.

Having formerly been instructed by the Committee to survey and report upon the practicability of making the river from Norwich to Yarmouth capable of being navigated by vessels of burthen, which might proceed at once to sea without re-shipment or delay at Yarmouth; and having, in compliance with such instructions taken the necessary steps for that purpose, I submitted to the Committee my report and estimates on the subject, which were approved and laid before a public meeting on the 18th of September, 1818. From the importance of the subject to the trading and commercial interests of the City, the Committee were then requested to continue their labours in furtherance of the object to be obtained. In consequence, at a subsequent meeting of the Committee, at which were present the members for the City, and other gentlemen eminent for their ability and judgment, I was then instructed to go over the matter again, to examine particularly whether any means of getting to sea were practicable otherwise than by Yarmouth Haven, in order to avoid the frequent delays occasioned by the state of the bar at the mouth of that harbour, as well as to obviate many other supposed objections to the plan. The possibility of a route by Lowestoft was submitted to the Committee, and to this I was particularly requested to direct my attention; but being precluded during the early part of last spring (on account of the state of the ground) from obtaining the requisite surveys of the land in time to complete my plans, and an almost constant succession of calls on professional business at a great distant from home, prevented my being able sooner to lay before the Committee my thoughts, plans, and estimates on this subject, but which I now most respectfully beg leave to submit to their notice.

General view of the Subject.

In taking a general view of the country between Norwich and Lowestoft, it appears very naturally formed for a navigable communication, being one entire level of marsh lands, and, with the exception of about a mile and a half, a water communication at present exists from Norwich to the sea, at a point ten miles nearer the Thames than the passage by Yarmouth, together with an excellent harbour capable of containing many hundred vessels in Lake Lothing, within four hundred yards of high-water mark. The most eligible line appears to be, in going from Norwich, to leave the river Yare at Reedham, and by a new cut or canal of communication of about two miles and a half long, to join the river Waveney, a little above St. Olave's Bridge; proceeding along the Waveney to Oulton Dyke, and through that into Lake Lothing, from which a cut of less than five hundred yards would be in deep water of the sea.

The width and depth of the Norwich river is stated in my former Report on that subject, and with the exception of a short distance at the Norwich end, is quite sufficient for the intended purpose.

The river Waveney, from the point where the new cut is supposed to enter to the mouth of Oulton Dyke, is extremely favourable to the measure, being nowhere less than thirteen, and in most parts from sixteen to seventeen feet deep, with very steep shores. Oulton Dyke, which is about a mile and a quarter long, would require to be enlarged and deepened, but Oulton Broad and Lake Lothing are at present of sufficient depth, and the latter, which in its present state is from ten to twelve feet deep, is now between four and five feet below high-water mark.

Such is the general view of the subject, and in entering into particulars, I shall direct the attention of the Committee to the following heads, viz.:—

Heads of Report.

1st.—The line of communication from Norwich to the sea at Lowestoft, compared with the line from Norwich to the sea at Yarmouth, showing the advantages of the former over the latter, *taking it for granted that a harbour can be kept open at Lowestoft.*

2nd.—Remarks on that tract of the Norwich river which would form a part of the new line, and which is noticed in my former Report on the subject of making the river navigable to Yarmouth.

3rd.—The canal of communication between the rivers Yare and Waveney, and the continuation of the line along the latter river, and through Oulton Dyke, Oulton Broad, and Lake Lothing.

4th.—The communication of Lake Lothing with the sea, with observations on that piece of water as a Harbour, and reasons why a deep passage may be kept into the sea, and a bar at the mouth of the Harbour prevented.

5th.—Some general observations on the whole subject.—And

6th.—The estimate of the probable expense of carrying this work into execution.

Comparison of the Line by Lowestoft with that by Yarmouth.

1st.—In reverting to the first of these heads, viz., the comparison of the proposed line with that of the present river by Yarmouth, it will be seen on referring to a good map of Norfolk, or the map sent herewith, and drawing a straight line from the Cathedral at Norwich to the lighthouse at Lowestoft, that no part of the proposed navigation extends two miles on either side that line, the greatest distance to the northward being a place called the Brick-kiln, at Brundall, on the Norwich river, and the greatest distance to the south of the above straight line is at Oulton Dyke, between Lake Lothing and the Beccles river; it is also worthy of remark, that in its course the proposed navigation touches the direct line in the following places, viz. 1st, opposite Trowse Newton-ball; 2nd. at Wood's-end; 3rd, at Langley Staithe; 4th, at Hardley Staithe; 5th, at Hardley Cross; and 6th, on the river Waveney, at the point where the proposed new cut enters it.

On drawing a similar strait line from Norwich Cathedral, as before, to the church at Yarmouth, it will be observed that the river takes a circuitous route, extending to a distance of near six miles to the southward, and never once comes near the above line from leaving Norwich till it arrives at Yarmouth. The difference of the distance by these two routes to the same point, viz., a station in the sea opposite Lowestoft Harbour, is ten miles, and the facility with which a vessel could get to

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sea from Norwich by Lowestoft, in preference to the route by Yarmouth, with the wind anywhere to the northward of the east, will be seen on referring to the map. For the valley of the Yare, which from Norwich to Hardley Cross goes in a direction considerably to the southward of the east, takes a sudden bend at that part, the general direction of which is north-east; so that a craft coming from Norwich, with the wind at north-east, which may be deemed for the average of the reaches a close-hauled or leading wind, would, on arriving at Hardley Cross or Reedham, have the wind dead a-head all the way down to Yarmouth; but in case the passage by Lowestoft were adopted, instead of having to turn to a head wind at Reedham, a course through the new cut at Norton, and into the Beccles river, would have the same wind on the beam, or nearly at large, down to Lowestoft, which would have been dead a-head to Yarmouth; besides which the coast just to the southward of Lowestoft point lying so much toward the south than the coast at Yarmouth, a vessel would be enabled to get out to sea at Lowestoft with the wind at least three points nearer the east than she could at Yarmouth, setting aside the chance of not being able to get over the bar of the latter haven, which is a casuality not to be dreaded at Lowestoft, as will be shown hereafter.

Remarks on the Norwich River.

2nd.—In remarking on the Norwich river, it will appear from my former Report and plans, which were made from actual survey, that the river would only require to be deepened in places between the Foundry Bridge and Whittlingham. But from the latter place downwards, it is of ample depth, being nowhere less than ten feet, and in some places upwards of fifteen feet deep for considerable distances. Some slight deviations of its course, or taking off sudden bends or points, would be requisite in particular places, as on reference to the map herewith sent may be seen; but in general the depth and width are amply sufficient for all the purposes required in the inland navigation of sea-borne vessel of the draught and tonnage proposed.

New Cut.

3rd.—The canal or new cut proposed to join the Yare with the Waveney, is marked down on the map in two places, both leaving the Yare at the same point, but terminating at different parts of the Waveney, one a very short cut entering the latter, below St. Olave's Bridge, and the other a longer one, entering the Waveney above the said bridge. The latter,* although rather the most expensive, is by far the most eligible, for the following reasons:—It may be adopted without having to obstruct the navigation of the Beccles river, or the traffic of the high road over St. Olave's Bridge, neither would that bridge have to be touched; but by having a small swing bridge where the new cut crosses Haddiscoe Dam, a free passage would be obtained for a roadway to the marshes lying between the new cut and the rivers Yare and Waveney, which, if the short cut were adopted, would be entirely insulated; besides, by adopting the longest cut, the passage is much more direct, and numerous turnings of the river avoided.

Nothing can be more favourable to a canal for connecting the two rivers at this place than the level of the rivers themselves, and the height and quality of the land between them. In taking the levels, I found both the rivers the same height at the same time of tide, and the land between them perfectly flat, and about two feet below the surface of the river, so that in forming the canal, there would be no waste or want, with regard to the soil excavated, as just sufficient would arise to form ample embankments on each side, neither would the mills or the drainage of the lands on either side be cut be at all affected by the measure.

River Waveney and Oulton Dyke.

From the place where the cut enters the Waveney, to the mouth of Oulton Dyke, that river is upwards of thirteen feet deep, with remarkably steep shores. Oulton Dyke, which connects the Waveney to Lake Lothing, is little more than one mile in length; its depth varies from four and a half feet to six feet, and is in places very narrow; but is so situated that it may with ease be stopped off at both ends, the water drawn off by a steam engine and widened and deepened to any required extent; the soil arising from which would make excellent embankments for the adjoining marshes, particularly those to the south side of the Dyke.

Oulton Broad.

Between Oulton Dyke and Mutford, is the piece of water called Oulton Broad, which is of depth sufficient, being from eleven to twelve feet deep at the end next Mutford Bridge, and nine feet at the end next Oulton Dyke.

Remarks on the whole Line.

As this Broad would be the termination of the fresh water navigation, it may be observed, that for *length*, *depth*, and *facility of working*, there is scarcely such another line of inland navigation capable of being made eligible for sea-borne vessels, at so small a comparative expense at this, in the kingdom. For from Norwich to Mutford Bridge is one entire level of twenty-five miles without a lock, with only one bridge (a swing bridge at Haddiscoe Dam) and capable of being navigated at all times uninfluenced by tides, and if tug vessels are used, I may say uninfluenced by winds also. The Oulton Broad would make a most excellent basin for vessels to lie in, preparatory to locking into Lake Lothing; and the latter a most excellent harbour communicating with the sea. But although so near, these two fine pieces of water would have no free communication with each other: they would be joined by a double lock with gates pointing both ways, so that the salt water could never extend beyond the causeway at Mutford, nor would any of the fresh water in the Broad and rivers below be wanted to go out at Lowestoft; the provisions for keeping which open, as a harbour, will come under consideration in the next place.

Lake Lothing.

4th.—The Lake Lothing, which extends from Mutford Bridge to within four hundred yards of the sea at Lowestoft, is well formed by nature as a Harbour, whether considered as to its size, depth, surrounding shores, continguity to the sea, and comparative height or level of its surface with that of

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* This is the only one shown in the engraved map accompanying the printed Report.

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the sea at high and low water, each of which properties may be described as at present existing, in order to show, when collectively taken, there could not be a doubt as to the practicability of effecting a good harbour.

The length of this lake is upwards of a mile and a quarter, and its average width from two hundred and seventy yards to two hundred and ninety yards, being a superficial content of at least one thousand three hundred acres, the average depth of which, for considerable breadth of the middle, is about ten feet in its whole length.

The shores are on both sides very steep, and the high lands on both sides come very near together at the end by Mutford Bridge, from which circumstance the necessary embankment, to prevent the influx of the tides to the extensive levels of marshes, would be but small, and could be rendered far more efficient in that situation, protected from the swell of the sea, than the present causeway of sand which divides the sea from the lake at the south entrance to Lowestoft.

The distance of the eastern end of Lake Lothing to the common high-water mark of spring tides is less than four hundred yards; and the average spring tides flow from four feet and a half to five feet and a half above the present surface of the water in the lake; and the spring ebb tides fall from four to four and a half feet below the same. So that in the event of making this a harbour, it would be from fifteen to seventeen feet deep every tide, which depth might be retained or not, as occasion would require, for as there would be no land waters to provide a passage for, the waters in the harbour might be suffered to ebb and flow with the tide, or be shut in at any tide, and discharged again at low water, for the purpose of either scouring the harbour or deepening the passage. But even this resource, which would be a certain method of obtaining a deep passage, even if the shore was as flat as that part of the coast near Yarmouth, would in this case most probably be very seldom made use of.

In taking a cursory view of the eastern coast of Norfolk, and being told that Yarmouth and Walberswick, one to the north and the other to the south of Lowestoft, were very much incommoded by having a bar formed at the mouth of their harbours, it would naturally be asked, would not a bar be formed in the same manner at Lowestoft?

Lowestoft Harbour.

REASONS WHY THERE WILL BE NO BAR—REASONS FOR NOT FILLING UP.

To answer this satisfactorily, the attention must be directed further than the eye-sight extends, and reference must be had to the grand natural causes which influence the action of the sea on this coast, in order to show why some parts of the coast lying in one direction will always have a flat shore, and others only a few miles off have a very steep shore. The cause of this is in some measure exemplified by the course of a river. Whilst it runs in a uniform straight course, the shores will be uniformly of the same general slope into the water, but if any obstacle present itself on one side to the course of the current, the opposite side below directly feels it, the shore on that part becomes deeper and steeper from the particular action of the current, and a shoal will be formed just below, and on the same side with the obstacle, after which it goes on the same as before, if no other impediment be offered. This effect of the action of a current of water upon the sides of every river must be daily witnessed by every one. And that the self-same causes and effects exist in the formation of the coast between Cromer and Harwich will be equally evident; for it must happen, that the general effects of a large river on its shores would be equally the same even if one of its shores was just below the surface of the water, so as to be hidden from view. If we take a view on the large scale of the line of coast just alluded to, we shall find that the sea for a few miles in width from the coast is in fact a large river; the line of coast forms the highest and visible bank, and the immense chain of sand-banks extending from Foulness, almost without interruption, to the southward of Lowestoft, forms the lower and invisible bank, and this will be more particularly seen from Wintertonness to Lowestoft Point, an extent of about twenty miles of sand-banks, which are, in fact, quite dry in many parts at low water. Beginning at the northward, they consist of the Scroby Sand, St. Nicholas or Yarmouth Sands, Corton Sands, and the Holm; the only break in the continuation of the sands is that of St Nicholas Gat, opposite Yarmouth; the general direction of this line of sands is very parallel to the coast from Winterton to Corton, where the Holm Sand takes a circuitous bend round Lowestoft Point, and at the same time comes suddenly nearer the shore, terminating in a point just below, or to the southward of Lowestoft Point, leaving an open passage called the Stanford; this is the most southerly opening, or end of this large sea river (if it may be so termed) commonly called Yarmouth Roads; the most northerly end is opposite Winterton, through a passage called the Cockle, the only branch or lateral opening being to the south-east of Yarmouth, called St. Nicholas Gat as before described.

Yarmouth Haven.

I have been the more particular in describing these sands, being fully persuaded that it is from these in conjunction with the flow and ebb of the tides we may look for all the circumstances which have occurred, and are daily occurring with respect to the filling up of St. Nicholas Gat, the extraordinary accumulation of bar at Yarmouth, and the sudden steepness of the beach just below Lowestoft Point: and it would be no difficult task to prove by fair argument, that the very causes which operate to fill up St. Nicholas Gat, and lay up a bar at Yarmouth, are the same that tend to deepen the water close to the shore at Lowestoft. But as what regards the deterioration of Yarmouth Haven does not come under my instructions, I shall proceed to show by one example of the effect of a flow and ebb tide, how the above effect is produced at Lowestoft, and would continue, without any interruption from the opening a passage into Lake Lothing.

Effect of the Flow and Ebb Tides in Scouring the Coast at Lowestoft.

Taking a flood tide, uninfluenced by particular winds, and supposing the whole could be seen at one view, the operation would be as follows: entering between the coast and the sands at the Cockle, the tide flows between two regular and nearly parallel banks from about eight or nine miles to the north, as many to the south of Yarmouth, where, meeting an obstruction by the Holm Sand, the current is diverted toward the shore just below Lowestoft Point, which it scours out at that place and expends its force on the high grounds at Pakefield, the effects of which are shown by the constant falling down of the cliffs, and the accumulating of the Barnard Sand off that place.

On the other hand, at the tide of ebb, the current sets with great force on the coast below Lowestoft, which facing the south-east, turns it off again, the effect of which is to keep laying sand upon Lowestoft Point, so that whichever way the tide sets, from the peculiar formation of the sands, combined

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with the coast, it produces all the effects of a large river running parallel thereto; another circumstance to prove the truth of this position is, that the filling up, or, as it may be termed, the death of St. Nicholas Gat was the birth of the Newcome Sand.

Reasoning from the above circumstances, it may fairly be inferred, and is most decidedly my opinion, that opening a passage from Lake Lothing into the sea, capable of taking one hundred ton vessels, or, in fact, a vessel of any tonnage would not in the least affect the general action of the tides upon that part of the coast. For in the first place, there would be no fresh water dribbling, as it were, into the sea, and assisting the waves to form a bank of silt at its mouth; and in the next, if necessary, all water might at times be prevented from entering, which would leave the case precisely as it now is; and to clear a passage, the whole of the contents of Lake Lothing could be discharged at low water, which, with an eight or nine feet fall in four hundred yards, and one hundred and sixty acres in extent would doubtless drive a passage more than deep enough at low water for any vessels that could ever want to enter.

5th.—In looking to the advantages that might be derived to the City of Norwich from the adoption of a plan of this kind, they are so numerous, and of such a nature, that the Committee will doubtless appreciate them much better than I am able to describe, and that their anticipation will render any representation of mine unnecessary. To the shipping interest, which generally navigate this coast, the advantages of a safe harbour in this place will doubtless be seen; and as a dock for the accommodation of fishing boats, which now lie for the greatest part of the year exposed on the beach, the benefit I conceive would be great. Much more might be said on this particular head, but as the Committee are well aware of the importance of the subject, and the interest it involves, they will no doubt state them in their own way, in their Report, to a public meeting. I shall therefore proceed to my sixth and last head, the

Estimate of Expenses.

	£
Works at Norwich and along the river, as per former estimate revised	15,745
New cut across the Norton, Raveningham, and Thurlton Marshes	8,200
New swing bridge at Haddiscoe Dam	3,000
Deepening and widening Oulton Dyke	4,000
Lock and bridge at Mutford	8,500
Stop and flood gates and bridge at Lowestoft	11,500
New cut from Lake Lothing to the sea (400 yards)	5,000
Driving two short piers to obtain 12 feet at low water	10,000
Extra works in laying water courses under the new cut at Norton, and making an embankment at the road near Mutford Bridge	3,500
Purchase of engines and implements	5,000
Contingencies	12,555
	£87,000

Wm. Cubitt.

No 265. Walker, on making a Ship Navigation from Lowestoft to Norwich.

No. 265.

Report on the Plan for making a Ship Navigation from the sea at Lowestoft to Norwich, by James Walker, Esq., C.E.

Sir, *Limehouse, January* 19*th*, 1826.

I have surveyed the proposed line of navigation between Norwich and the sea at Lowestoft, as well as the rivers near to it, and the district of land likely to be affected by it, for the purpose of being able to give an opinion on the various points referred to me by the resolution "of the Committee of the Corporation of Great Yarmouth, appointed to watch the proceedings of the proposed Norwich Navigation Company." I have also employed Mr. Timperley, a gentleman upon whose experience and accuracy I could depend, to make a minute and detailed survey of the coast of lake Lothing, and of the rivers and district as far as Reedham: and as the inquiry might involve questions of comparison, and of affects upon the present navigation, I have had this detailed survey continued by the rivers to the Braydon, and thence to the sea at Yarmouth.

My intention was to have applied the information thus obtained to the designs for the proposed undertaking; but this object cannot be accomplished, nor (excepting as regards the direction of the proposed navigation) can any particular conclusion be arrived at with certainty, from the copy of the deposited plan which you have sent me; neither the level of the navigation, as compared with the marsh land through which it is to be made, nor the situation of the lock-gates or other defences against injury, being anywhere pointed out. Therefore, until I receive from you the information I have applied for, and more particularly a section of the lands between lake Lothing and Reedham, showing also the proposed level of the new cut as respects those lands, I cannot draw any particular conclusion as to the probable affects upon them.

I would, however, state generally, that if the proposed height of the water is not to be above the present level of the Yare and the Waveney, and if the influx of the sea is to be prevented from going farther than Mutford bridge, the embankments across the marshes, and at Mutford bridge, may be so formed and raised, and works constructed at Mutford bridge of such strength and height, and the same so guarded and protected afterwards, as to preclude all rational fear of danger to the low lands. To say otherwise would be to pay but a poor compliment to science, and could only tend to encourage an opposition, which, as it could not succeed upon inquiry, would certainly be injurious to other and more rational grounds of objection.

It is also fair to state, that Mr. Cubitt, the company's engineer, stated to Mr Timperley, in conversation some months since, that a lock, with two pairs of gates, pointing each way, was proposed at Mutford bridge; and that one pair of gates, pointing inwards, was intended at the east end of lake Lothing, but that the particular situation and dimensions of those works were not determined.

A newspaper letter you have since sent me, signed by Mr. Taylor,—the same gentleman, I presume, whose name is attached to the plans, as surveyor to the proposed company,—confirms this information. The letter referred to argues, however, as if no additional height in the rivers were to be the con-

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sequence of an entire removal of the present obstacles to the free admission of the tide at Lowestoft,—a conclusion which I cannot admit, and which Mr. Taylor's premises by no means justify; on the contrary, I think that such a measure would require the whole of the marsh lands near the opening to be embanked at the least six feet higher than they now are (a work of great labour and expense), and also that the expense of drainage would be very much increased thereby. If Mr. Taylor's remarks are at all meant to prepare the public mind for the measure to which he refers, the interests of Yarmouth also become concerned in guarding against it, and in preventing any attempt to open a free communication between the rivers and the sea at Lowestoft. The effect of such a plan would be to divert part of the current, to which Yarmouth harbour owes its depth, into another direction, and thus in the attempt (and, as I think, vain attempt) to make a new harbour, perhaps to ruin the old one

It is reasonable, however, to conclude, that gates are intended, although they are nowhere shown upon the plan; and should the measure proceed, it will be proper to attend to the enactments respecting them, as well as to the future level of the water in the navigation, which, were I to judge from the cross section of the proposed cut between the Yare and the Waveney (and this is all I have to judge by), is intended to be even below the present level of the rivers; that is, if the lines outside the embankment, in the cross section referred to, are intended for the level of the marsh; and if this be not so, the level of the land, as compared with the proposed cut, is shown nowhere. Mr. Timperley's survey makes the highest part of the marsh under the ordinary water level of the rivers, as indeed the present embankment shows it to be, while the cross section referred to shows the proposed level of the water below the marsh level. If this be so intended, it can be done only by a lock at each end of the cut, which ought to satisfy the minds of the most timid land owners between the Yare and the Waveney, and dispel the fears of such as apprehend a diversion of the water of the Yare into the new channel; but as I have never heard of such locks, and as they would be attended with considerable expense, and also delay in the passage of vessels, I am rather disposed to think that the lines I have referred to are not intended to show the level of the land.

Mr. Timperley's levels, at the time his survey was taken, make the high-water mark in the Yare, at Reedham, five inches higher than in the Waveney, near St. Olave's bridge, where the proposed cut is to join that river. If this be the case generally, the water of the Yare may be diverted in part by the new cut and along the Waveney, to the prejudice of the Yare below Reedham. This may be prevented by a regulating lock upon any part of the cut, the use of such a work being previously well ascertained. The difference of distance from Norwich to the sea, by Yarmouth or Lowestoft, is but small, but what is, appears by the surveys and plans to be in favour of Yarmouth.

Such are the observations that present themselves to me in reference to the engineer's department of the inland part of the proposed scheme: I am sorry they are so loose, but the scantiness of the information supplied by the plan you have sent me makes me unwilling to speculate upon what is not perhaps intended to be done, and it might have been considered unfair not to have noticed the reports and information to which I have referred.

The natural advantages of the rivers Yare and Waveney, their capability for vessels of greater burthen than now navigate them, and the fact that the principal impediments to such vessels lie between the mouth of the Yare and the sea, are stated in all the reports, and cannot be denied; but whether the increased capabilities would be equal to the expense of creating them, or whether goods could be conveyed to Norwich in the same vessels that bring them from the sea at a less rate or freight than at present, are points upon which there appears a great diversity of opinion with those who, if they are disinterested, have the best opportunities of judging. If the conclusion of a fair and liberal inquiry be in favour of making the water conveyance to Norwich fit for sea-going vessels, the most reasonable, as well as the most economical way is, as Mr. Telford has stated, to improve the present navigation by the way of Yarmouth.

I do not intend this observation to refer to any particular plan for making such improvements, as whether the better way be to improve the Braydon, or to avoid it, but as a general position, of which I think there can be no doubt.

To form a navigation from Lowestoft, even were there no natural impediments, which I think there are, would at the best be to divide the trade, which would have the effect of lessening the revenue; and this, like the dividing of the waters, would tend to the ruin of the certainly very important national harbour of Yarmouth,—a consequence which even the increased facilities to the commerce of the interior would by no means justify, were they made equal to the utmost hopes of the warmest advocates for a ship navigation.

In saying that there are natural impediments, I refer almost entirely to the entrance at Lowestoft, and more particularly, first, to the great, and, as I think, insurmountable difficulty of maintaining a sufficient depth of water between the sea and lake Lothing; and, secondly, to that of ships entering during the most dangerous winds, even were it possible to maintain a sufficient depth The first of these comes more especially within my province.

The direction of the shore, where the outlet is proposed, runs north-east; the entrance points to the north of east. The length of the entrance from lake Lothing to high-water is about 720 yards upon the plan; the depth in the entrance is drawn 12 feet under low water, the width at bottom being 73 feet, and the low water width 109 feet. The south side of the entrance is intended to be wharfed; the north side is drawn without wharfing, at a slope of three feet horizontal to one foot perpendicular; and the shingle, or sand, is supposed to remain at that slope, so as to preserve the bottom width and the depth already stated.

Now, as the bank between the sea and the lake is composed principally, or wholly, of loose sand and shingle, materials of which the shifting nature, where they are exposed to the action of the sea, must be admitted, it is evident that any excavation made in the present bank would very speedily be filled up again, unless kept open by some continued force, sufficient to carry off the shingle that would be constantly thrown into it. I can scarcely conceive a more vain and abortive attempt than that of keeping up an excavation, or opening, through such a beach as that of Lowestoft, without a sufficient back-water; and upon this point there cannot, I apprehend, be any difference of opinion.

Will lake Lothing form such a back-water?

This is a cardinal question for the projectors of the new navigation to have carefully considered; for if the answer be in the negative, as I think it must, there is an end to the idea of an entrance at Lowestoft; but if in the affirmative, it is fair to say that the great physical difficulty of the whole scheme is removed.

The area of lake Lothing is, by Mr. Timperley's survey, which agrees nearly with Mr. Cubitt's,

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only 141 acres: the average rise at sea may be taken at six feet; but as this is the difference between the points of high and low water, the actual difference for the time of a scour cannot be taken at more than five feet, or at the most five feet six inches; from this is to be deducted the fall in the surface of the water in the lake towards the gates, when the sluices or flushes are open, and also the rise from the level of the water at sea towards the gates. The effective difference of level at the gates cannot therefore be taken at more than four feet.

Now, from calculations made from these data, I have no hesitation in saying, that this head, discharged through sluices of very great size indeed, will not produce such a velocity, nor half such a velocity in the entrance, as would be requisite to keep open a channel of the proposed width and depth. But this is without any allowance for the obstruction and loss of power, which will be caused by the shingle that will necessarily accumulate in the passage during the flood-tide, and which, in high winds, will, I apprehend, sometimes be such, in one or two tides, as altogether to block up the passage for a time, or at least to such an extent as to prevent the scour until an opening be made by manual labour.

Again, the calculations to which I have referred have been made upon the supposition that the shingle, forming the north side of the entrance, will stand as shown, at the slope three horizontal to one perpendicular. But this is not to be expected. The present actual slope of the shingle, which forms the shore fronting the sea, is nine or ten horizontal to one perpendicular between high and low water, and twenty to one under low water; that is, on the average, above and below low water, five times a greater slope than is proposed for the new entrance. Now, should such, or nearly such long slopes be formed (and I think it natural to expect that they will be), the top width of the entrance will be so much increased as to diminish the bottom width as well as the depth, and so render the passage comparatively useless for the important objects named in the various statements I have seen.

The effects of the shingle or sand will not even be confined to the entrance, but when the water is much agitated, and the gates opened by a high-flowing tide, it will, I think, be washed into the lake, and cause an obstruction there, as well as prevent the shutting of the gates; evidently with the assistance of the waves, the wash into the harbour will, at such times, be greater than that out of it: and as I really think that the gates can by no means be depended upon, this cause alone appears to me sufficient to prevent the possibility of keeping clear the east end of the lake and the passage, and therefore to be almost a sufficient argument against a harbour there.

My decided opinion therefore is, that it will not be possible, by means of the back-waters afforded by lake Lothing, to maintain a passage between the sea and the lake at all approaching to the width and depth shown in the section, or such as to be useful as an entrance to a harbour. To calculate upon its being kept down to the level of low water is probably as much as should be; and even to do that, would require very considerable manual aid, and could never answer the expectations of the projectors, as respects either their public motives or their private interests.

But it may be intended to procure a scour, by allowing the tide to ebb and flow freely as far as Mutford bridge, and thus to avoid the expense and danger of lock-gates, which are certainly not desirable things so near the mouth of a harbour, and upon so rough a coast. I have tried the calculation in this way also, and find the velocity not to exceed one mile per hour through the proposed section. Even in this way, the obstruction, which will be caused by the bridge of a public road crossing the entrance of the harbour, leaves the matter in no better plight. This bridge, which must generally be kept shut, and particularly during the night, is also of itself a serious objection to the idea of a harbour at Lowestoft.

For the above reasons, Yarmouth has, I am sure, nothing to fear from Lowestoft; and were the harbour, and the works between the sea and Mutford bridge, obliged to be completed, and their efficiency and permanency proved before the inner works and cuts be begun (and this would appear a reasonable demand on the part of the opposers, and a prudent plan on the part of the projectors), I mistake much indeed if the proceedings would ever be carried farther. Yarmouth might, I think, safely trust to the issue of such an experiment; but I hope that both parties will see that their real interests are so identified, as to render even this expensive experiment unnecessary.

The other material question, viz., the safety of the entrance to the harbour for vessels under sail and during gales of wind, may be answered by others much more competent to the task than I am.

It appears to me, that the proposed channel is too narrow for this purpose, and that great danger would result, unless vessels could be brought to anchor before entering the channel, which in times such as I have stated is out of the question.

It is also evident, I think, that from the entrance pointing considerably to the northward of east, it is not intended, or at least is ill suited, for affording shelter to vessels during south and south-east gales, which are the most fatal to shipping upon this coast. This roadstead is, besides, particularly exposed to those winds, and a harbour would be most likely to be useful while they prevail: I cannot conceive how vessels can be expected to enter, in safety, during such winds. From the entrance being under 100 feet in width, there must be great difficulty in entering at all with a heavy wind, particularly from the south; and supposing this accomplished, the danger of striking upon the wharfing on the one side, of grounding upon the slope on the other, or, if the gates be shut at the time, the risk of ships in the passage running foul of each other, or of the gates at the entrance of the lake, all appear to be of so serious a nature, and to prevent the idea of any ship running to Lowestoft for safety under such circumstances.

Mr. Timperley has made an accurate survey and taken soundings of the coast for eight miles in length, and to a great distance from the shore, to ascertain the correctness of the statements made by Mr. Cubitt and Captain Nicholls, as to the passages, the depths of water, and the position of the sands, and has found them generally to be correct.

As to the probable expense of the works, it is impossible for me to say anything, owing to the want of information to which I have referred. The confirmation which Mr. Cubitt's estimate has received from Mr. Telford is a powerful argument in its favour.

To conclude, the general result of all my considerations is, that the natural Port of Norwich is by Yarmouth; to separate them, were it possible, would be injurious to both, and both parties are, I am convinced, blind to their own interests, if they either desire a separation, or refuse to each other those facilities which each has the means of affording to the other, and by which the party appearing at first to grant the facility may, in the end, have the greatest benefit.

Samuel Tolver, Esq.,
&c., &c.

I am, &c.,
J. WALKER.

APPENDIX B.

LOWESTOFT.

No. 266.

Register of Tide Observations at Mutford Lock.

No. 266.

REGISTER of the Tide Observations at Mutford Lock, from the 6th to the 15th of November, 1845, both days inclusive.

IN OULTON BROAD.

☽'s		Date.			High Water Height.	Low Water Height, From Zero.	Duration of		Amount of	
Age.	Phase.	Day.	A. M. or P. M.	Time.			Flow.	Ebb.	Rise.	Fall.
				H. M.	FT. IN.	FT. IN.	H. M.	H. M.	FT. IN.	FT. IN.
		Nov. 6	..	5 30	0 1 −					
								5 30	..	0 11
6 5	+	..	..	12 00	..	1 0 −				
		,, 7	..	5 55	0 1 −					
								6 25	..	1 1
7 5	..	..	..	12 20	..	1 2 −				
		,, 8	..	7 30	0 3 −					
								5 55	..	0 11
				1 25	..	1 2 −				
							6 35	..	1 2½	
8 5	..	..	..	8 00	0 0½ +					
								5 50	..	0 8½
				1 50	..	0 8 −				
							6 25	..	1 0	
		,, 9	..	8 15	0 4 +					
								7 45	..	1 0½
				4 00	..	9 8¼ −				
							5 00	..	0 9½	
9 5	..	..	..	9 00	9 1 +					
								6 30	..	0 8
				3 30	..	0 7 −				
							5 50	..	1 0	
		,, 10	..	9 20	0 5 +					
								6 40	..	1 2
10 5	..	..	..	4 00	..	0 9 −				
		,, 11	..	10 00	0 5 −					
								6 40	..	0 11
11 5	..	..	..	4 40	..	0 6 −				
		,, 12	..	11 00	0 6 −					
								6 00	..	0 9
12 5	..	..	..	5 00	..	0 3 −				
		,, 13	..	11 50	0 11 +					
								6 40	..	0 10
13 5	..	..	..	6 30	..	0 10 −				
	+	,, 14	..	12 40	0 9 +					
								6 20	..	0 11
14 5	..	..	..	7 00	..	0 2 −				
		,, 15	..	1 30	0 6 +					
								6 20	..	1 2
15 5	..	..	..	7 50	..	0 8 −				
		,, 16	..	2 00	0 0½ −					
16 5	..	..	..	..	..	..	..	6 20	..	1 0½
IN LAKE LOTHING.										
		Nov. 6	..	2 35	0 9 +					
								6 25	..	4 11
6 5	+	..	..	9 00	..	4 2 −				
		,, 7	..	3 20	0 9½ +					
								6 00	..	5 6
7 5	..	..	..	9 20	..	4 0 −				
		,, 8	..	4 22	1 00 +					
								5 53	..	4 8
				10 15	..	3 8 −				
							6 45	..	4 8	
8 5	..	..	..	5 00	1 4 +					
								5 40	..	3 5
				10 40	..	2 1 −				
							6 35	..	3 6	
		,, 9	..	5 15	1 5 +					
								6 0	..	5 8
				11 15	..	4 3 −				
									6 6	
9 5	..	..	..	6 00	2 3 +	..	5 45			
								6 0	..	4 6
				12 00	..	2 3 −				
							6 20	..	4 1	
		,, 10	..	6 20	1 10 +					
								6 0	..	5 10
10 5	..	..	..	12 20	..	4 00 −				
		,, 11	..	7 00	1 9 +					
								6 30	..	5 11
11 5	..	..	..	1 30	..	4 2 −				
		,, 12	..	8 00	2 0 +					
								6 00	..	6 1
12 5	..	..	..	2 00	..	4 1 −				
		,, 13	..	8 40	2 6 +					
	+	,, 14	..	9 35	2 1 +					
								6 0	..	6 5
14 5	..	..	..	3 30	..	4 4½ −				
		,, 15	..	10 25	1 6 +					
								6 0	..	5 9
15 5	..	..	..	4 25	..	4 3 −				
		,, 16		5 00	1 4 +					
								6	..	4 7½
16 5	..	..	..	5 15	..	3 3 −				

APPENDIX B.

LOWESTOFT.

No. 266.

Register of Tide Observations at Mutford Lock.

By Direction of Mr. HODGES, C.E., *at Mutford Lock, 16th Nov.*, 1845.

ON LAKE LOTHING SIDE.

			Ft.	In.		
Low water	5	o'clock	4	9	below	Zero.
	6	,,	3	1	,,	,,
	7	,,	1	3	,,	,,
	8	,,	0	4	,,	,,
	9	,,	0	3	above	,,
	10	,,	1	0	,,	,,
High water	11	,,	1	4	,,	,,
	12	,,	0	9	,,	,,
	1	,,	0	2	below	,,
	2	,,	1	2	,,	,,
	3	,,	2	7	,,	,,
	4	,,	3	2	,,	,,
Low water 5h. 15m.	5	,,	3	3	,,	,,
	6	,,	2	4	,,	,,
	7	,,	1	0	,,	,,
	8	,,	0	0½	above	,,
	9	,,	0	5	,,	,,

ON OULTON BROAD SIDE.

			Ft.	In.		
Low water	5	o'clock	0	6	below	Zero.
	6	,,	0	8	,,	,,
	7	,,	0	10	,,	,,
	8	,,	1	0	,,	,,
	9	,,	0	11	,,	,,
	10	,,	0	9	,,	,,
	11	,,	0	6	,,	,,
	12	,,	0	3	,,	,,
	1	,,	0	1	,,	,,
High water	2	,,	0	0½	,,	,,
	3	,,	0	3	,,	,,
	4	,,	0	5	,,	,,
	5	,,	0	7	,,	,,
	6	,,	0	9	,,	,,
	7	,,	0	11	,,	,,
Low water 8h. 15m.	8	,,	1	0	,,	,,
	9	,,	0	11	,,	,,

No. 267.

Statement of sale of Harbour.

No. 267.

Norwich and Lowestoft Navigation.—Statement of Sale of Harbour.

Public Works Loan Office, South Sea House,
London, 3rd November, 1845.

SIR,

I have to acknowledge the receipt of your letter of the 1st instant, and in reply, beg to inform you that the Norwich and Lowestoft Navigation and Harbour were sold by private contract, and that there were no conditions of sale prepared with reference thereto.

The purchase money received by this Board was 4,935*l.*

I have no plan of the harbour and navigation, either with or without the soundings; all documents of that nature received from the Navigation Company, having been handed over to the purchasers.

I send a print of the Act 5th Vict. Session 2, c. 9, under which, and the other Acts regulating the proceedings of this Board, therein recited, the sale was made.

Also, a copy of the conveyance from this Board, which I must trouble you to return, and if you require it, a copy shall be furnished for the use of your Commission, as there is not time to make a copy for you to forward by this post.

To Joseph Hume, Esq., M. P.

I have, &c.,
J. S. BRICKWOOD, *Secretary.*

No. 268.

Loss by Exchequer Bill Commissioners on sale of Harbour.

No. 268.

Norwich and Lowestoft Navigation.—Loss by Exchequer Bills Commissioners on Sale of Harbour.

Public Works Loan Office, South Sea House,
London, 2nd April, 1846.

ABSTRACT, showing the advances by the Exchequer Bill Loan Commissioners, to the Norwich and Lowestoft Navigation Company; the receipts and repayments on account of those advances; the amount received by the sale of the works and property of that Company, and the loss on such advances.

		£	s.	d.
1st.	*Advances.*			
	26 March, 1832.	50,000	0	0
	27 March, 1835.	2,000	0	0
	21 May, 1835.	2,000	0	0
		54,000	0	0
2nd.	*Receipts and Repayments on Account of those Advances.*			
	On 21 November, 1839, on dismissal of Chancery suit against the Directors of the Company, instituted for recovery of the proportion of first advance not applied for works.	7,500	0	0
	The income derived from the Harbour and Navigation, during the Commissioners' possession was wholly absorbed in the current expenses of management and upholding the works.			
3rd.	*Amount received by the Sale of the Works and Property of the Company.*			
	On 10th November, 1842.	4,935	0	0
4th.	*Loss on the said Advances.*	43,279	3	8

J. S. BRICKWOOD, *Secretary.*

LOWESTOFT.

No. 268.
Loss by Exchequer Bill Commissioners on sale of Harbour.

Norwich and Lowestoft Navigation.

STATEMENT showing the Amount of Interest on Loans advanced by the Public Works Loan Commissioners for the Norwich and Lowestoft Navigation, calculated at 5*l.* per cent. per annum, from the dates of Advance to 10th November, 1842, the date at which the Work was sold, the Amount of Interest received, and the Aggregate Loss of Interest.

Amounts Advanced.	Dates of Advance.	Date of Sale.	Years.	Days.	Interest from Dates of Advances to Day of Sale.
£.					£.
50,000	26 March, 1832	10 Nov. 1842	10	229	26,568 9 10
2,000	27 March, 1835	,,	7	228	762 9 4
2,000	21 May ,,	,,	7	173	747 7 11
54,000	Total Amount of Interest . . .				28,078 7 1
	Amount of Interest received . .				Nil.
	Aggregate Loss of Interest . . .				28,078 7 1

J. S. BRICKWOOD, *Secretary.*

Public Works Loan Office, South Sea House,
13th April, 1846.

No. 269.

No. 269
Edwards, on the Improvement of Lowestoft Harbour.

Suggestions for the Improvement of Lowestoft Harbour, by G. EDWARDS, Esq., C.E.

Lowestoft, January, 1838.

OF all the objects of public enterprise, to which the necessities of the extending mercantile interest of this country, aided by the advancement of mechanical knowledge, have given rise, few have been of less certain result than the first formation of artificial harbours.

The histories of Dover, Ramsgate, Folkestone, Courtown, in Ireland, and of several other harbours, prove, that with every care and precaution which the local and scientific knowledge of the times could furnish, difficulty after difficulty has been but slowly overcome, during the lapse of intervening years of experience, whilst in some cases they have appeared so insurmountable as to cause for a time the total abandonment of the works in despair. Subsequent events have again made the importance of such works more manifest, and caused them to be re-undertaken with spirit, and with a practical knowledge, gaining by dear-bought experience, and thus by degrees they have been brought to an useful state.

The same gradual improvement marks the progress of many other harbours not altogether artificial, but whose present beneficial state is principally owing to the hand of man. The careful observation of the sets of tides and currents, the effects of different winds, and other causes of the formation of bars have required from time to time a suitable adaptation of piers, breakwaters, and other works, upon which the original projectors of the intended improvement could not calculate. To this fact the history of every harbour of the description alluded to abundantly testifies.

One of the artificial harbours of latest date is that of Lowestoft, in the county of Suffolk; and it has occurred to the writer, who has had the best opportunities of observation, that the harbour of Lowestoft, though under difficulties, is still capable of being made a permanent and efficient harbour for sea-borne vessels trading with the interior of Norfolk and Suffolk.

The existing difficulties to which this harbour is now subject, and for which a remedy is suggested, are as follow:—

1st. The slow but continually increasing accumulation of mud in Lake Lothing (the deposit of the sea water), to such an extent as already to interrupt the trade, and to diminish the backwater, and which (without a very large outlay in dredging) rapidly tends entirely to prevent the passage of vessels over the lake, and to reduce the backwater so as not to maintain the present depth of water over the bar.

2nd. The deficiency of water upon the bar occasioned by the want of piers, and the loss of time and uncertainty in the use of the present sluice-gates.

3rd. The insecure state of the masonry of the present lock at Lowestoft, and the consequent difficulty in using the sluice gates, which threaten to increase; impossibility of substantial repair without stopping the navigation, by the construction of dams; inutility of the present building as a lock from its too great contiguity to the sea, and the certain destruction of the gates by the worm.

4th. Vessels entering the harbour when a strong ebb is running out are unable to pass through the lock until the ensuing flood; this is also the case with vessels entering after the gates are shut for sluicing.

These difficulties may be removed, and, the undertaking placed in a state of permanent efficiency by the following means, viz.:—

By taking down and entirely removing the present lock, and by building one of similar dimensions of chamber much further from the sea. In the accompanying plan this removal is limited to the extent of land, already in possession of the Company, which is coloured green; this lock to be furnished with two pair of common lock-gates, pointing to the land, one pair constructed with turning or draw-gates within them for sluicing; a pair of flood-gates may also be provided in this lock pointing to the sea, for the purpose of keeping out very large tides; parallel and adjoining to the lock, to build a sluice with three 10-feet openings, or more if desirable to be closed also with draw or turning gates. The space between the new lock and the west end of the present iron piling to be formed as a wide entrance basin, bounded by very flat sloping shores, the sides and bottom, where necessary, to be protected with a covering of chalk or other rubble stone. An open gangway, supported upon piles, to be made along the south side, for the assistance of vessels. That part of the iron piling immediately adjoining the east end of the present lock to be drawn and re-driven in a line, returning towards the land on each side, as shown. The south pier to be carried out 100 feet, and the north piling to be extended 80 feet, and finished as a pier.

The effects expected from the alteration above described, are as follow:—

1st. Mud is now deposited in the lake in such quantities, as would cost, if it were removed as fast as it came in, about 2,000*l.* annually.

As the mud thus left is nothing more than the deposit of the sea water, rendered particularly thick by the vicinity of the sands, it follows, that if the lake were kept full without any addition of sea water, this accumulation would be entirely prevented, and this it is proposed to do, with the exception only of re-filling the lake from the sea after each sluicing.

Once sluicing on each spring has hitherto been found sufficient, that is, one tide in 30, and which, to continue this practice, would still be let into the lake; but as the opportunities of sluicing with advantage

APPENDIX B.

LOWESTOFT.

No. 269.

Edwards, on the Improvement of Lowestoft Harbour.

will be increased by the lake being kept full, suppose that one tide in 20 is still let in; consequently the mud brought in would be only one-twentieth part of its present quantity, and the annual cost of removing it 100*l*., instead of 2000*l*.

A channel once made to Mutford Bridge would be available at all times of tide. Wharfs, shipways, and other accommodations for business once made would be subject to no deterioration by the accumulation of mud, and consequently all the property abutting upon the lake would become available for any business connected with shipping or the navigation.

2nd. The present contents of the lake would suffer no further diminution as a backwater. Although the sluice-gates are proposed to be at a greater distance from the bar, the extra waterway to be provided by the additional sluices will not only maintain the scouring stream at its present velocity, but will allow of its being increased to almost any extent that may be found safe to the works. By these means, and by a small extension of piers, there can be no doubt of increasing the depth of water upon the bar from one to two feet, which, added to the present depth, varying from 9 to 10 feet, would be amply sufficient for the general purposes of the trade, and certainly for any sea-borne vessels adapted to an inland navigation.

A very great advantage would arise from the lake being always full, and therefore always ready for sluicing whenever occasion might require.

The greatest effect is produced upon the bar by sluicing when the low water of the sea falls lower than usual, not only because it leaves a greater head of water to sluice with, but principally because there being then a less depth of water upon the bar, the velocity of the stream over it is greater, and consequently its scouring effect is greater. Under present circumstances (the gates being always open) it is of course necessary to close them at the time of high water, or six hours before sluicing, besides which several hours are occupied in preparing them for closing by pumping out the caissons, dredging the sills, &c., so that altogether at least nine hours preparation is necessary; and as it is manifestly inconvenient either to open or to close them but by daylight, very little choice of time is left, unfortunately least in the winter months, when most is wanted.

If, as proposed, the lake was kept full, the occurrence of a particularly low ebb could immediately be taken advantage of: an extra foot of water on the bar might be made at a short notice, for the admission of a vessel of larger draught than usual, or advantage might be taken of the absence of many vessels from the harbour.

3rd. Experience has shown that no masonry of ordinary strength can long resist such exposure to the direct action of the sea as the present lock is subject to. No brickwork can permanently withstand the constant shaking and jarring caused by the motion of the present enormous sluice-gates, which it is impossible entirely to prevent.

Large repairs will shortly be necessary, and for that purpose expensive dams must be constructed. And after the water is pumped out, that stability of the lower part of the work may possibly not be such as to warrant a large outlay in repairs of the superstructure. The expense of dams for the new lock would not be greater than will be required for repairs of the present one. The bridge, stonework, and a large proportion of the bricks and other materials, to the value of at least 10,000*l*, would be available for the new lock.

The gates of the new lock and of the sluices may be coppered to preserve them from the ravages of the worms, which are destroying the present gates; or if they are not coppered they would not be so heavy, but that they might be occasionally lifted out for repair, or for the purpose of renewing the coating of pitch and tar which is found to be an efficient preventive so long as it remains entire. The difficulty and danger now experienced in managing the sluice-gates, during even a moderate swell, will be obviated by the greater distance of the new lock from the sea, and more especially by the quieting effect which would be produced by the seas expending themselves upon the flat shores of the entrance cut, instead of being conducted to the lock by the smooth surface of the piling as at present.

Vessels coming in before the wind would have distance and room sufficient to bring up either by letting go their own anchors and swinging, or by mooring to suitable buoys to be provided for that purpose along the centre of the entrance basin, or to posts on shore, previous to their being locked up.

Vessels running for the harbour with loss of anchors might, in failure of other means, bring up by running unto the sloping shore of the north side left for that purpose.

4th. Vessels entering the harbour and once safely within the piers, would be sure of getting through the lock, and would be able immediately to proceed over the lake on their destination to Beccles, Norwich, or elsewhere.

The revenue already derived from this harbour, though small, is sufficient clearly to prove that there are considerable advantages to be derived, both by the merchant and the consumer, by trading through this port. For in spite of the absence of the fostering care of original friends and projecters, in spite of the deficiency of water for ships, want of land for business, of agents, Custom House, quays, cranes, efficient and cheap steam-tugs, and with a heavy toll upon all the Beccles trade, the revenue does not materially diminish.

It is scarcely necessary to observe that these matters would remedy themselves when once the navigation is placed on a permanent basis.

No. 270.

Washington, on a New Channel into Lowestoft Roads.

No. 270.

Captain WASHINGTON'S *Report on the New Stanford Channel.*

Her Majesty's Ship Shearwater,
Lowestoft Roads, 29*th November*, 1842.

SIR,

It is with much gratification that I acquaint you that a new and available channel, carrying 20 feet throughout at low water springs, has recently opened itself directly through the body of the Holm Sand, into Lowestoft Roads.

Having heard from the pilots in the course of the autumn, that a 12-feet channel existed in a certain direction over the sands, which they termed the Fisherman's Gat, we proceeded to sound this passage in order that we might take advantage of it in running in and out of the Roads, while employed surveying on this part of the coast; but before the first day's examination was over, we found evident symptoms of a deeper and wider opening in a different direction, and a more complete examination has fully proved the existence of the above named channel, lying in a south-by-west direction from the Stanford Light Vessel,

You will probably remember that in 1834, or perhaps sooner, the Old Stanford Channel had begun to fill up, and that the only entrance into Lowestoft Roads was by the in-shore passage through the Pakefield Gat, in consequence of which, Captain Hewett was directed to re-survey this roadstead, the result of which was published by the Admiralty in 1836, and it is by comparison with that chart that I can better make you aware of the amount of the present extraordinary changes, all of which have taken place since that time.

First, then, Lowestoft Ness, which I believe to be the chief cause of the change in the sands, has grown out 70 yards since November, 1836, the date of the last survey, and this sandy Ness now projects rather more than 800 yards from the foot of the cliff, forming an invaluable breakwater against northerly and southerly gales.

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Washington, on New Channel into Lowestoft Roads.

Secondly, the Inner Shoal, as it is called, just to the southward of the South Ness, has spread considerably in breadth, and moved bodily to the eastward towards the Newcome Sand, and has now only 12 feet water on it, at a distance of little more than half a cable from the light-vessel, thereby almost blocking up the eastern channel.

Thirdly, the western edge of the S. W. Corton Sand, some distance north of the Ness, has advanced to the westward, the 12 feet line in some places occupying the position of the 24 feet line in 1836, thereby narrowing the North Roads.

These three causes combined appear then to have forced the current (most likely when increased by a high spring tide and northerly gale) to burst through the barrier of the Holm Sand, and to excavate for itself a channel, now 35 feet deep, where before was a sand bank with only one fathom of water on it.

One effect (or perhaps indeed a cause) of this disturbance has been, that the northern part of the Newcome Sand, from a width of one cable (between the 12 feet line) has spread itself out into a flat, nearly half a mile wide, and has moved bodily to the eastward and entirely filled up the Old Stanford Channel: so that where ships sailed in with occasionally a depth of six fathoms, only so far back as the year 1830, is now an extensive shoal, in places only 8 feet below the surface of the water.

Another extensive change is in the southern part of what must now be called the Holm Sand; here immediately opposite the Ness, the current has cut away a large slice from the western edge of the shoal, and in some parts there are now 12 feet water, where in 1836 was a sand bank, dry 6 feet above the surface; generally, too, this shoal does not dry over above half the space it formerly did

But all these changes are more than compensated by the opening to which I have before alluded. Here is a passage, which perhaps I may venture to name the "New Stanford," or "Shearwater" Channel, nearly one-third of a mile wide, with 20 feet throughout at low water springs, leading direct to the light-vessel, and enabling ships that may be caught to the southward in a S. W. gale, and cannot fetch into the Pakefield Gat, to run with a fair wind on a N. ½ E. course into Lowestoft Roads; it will also enable vessels which break or slip from their anchors in Yarmouth Road in a N. N. E. gale, instead of running to leeward for the Pakefield Gat, and thereby risking the being carried on the Barnard, to stand clear out to sea with a fair offing from the shoals under their lee, with the additional advantage of not having to make a circuitous course, and to run the gauntlet through all the shipping that in blowing weather always fill this roadstead.

Herewith I have the honour to transmit a chart, on the scale of eight inches to a nautic mile, showing the new channel, and the present state of the Holm and Newcome Sands; from this it will be seen that all that is left of the Old Stanford consists in a few holes only 2 feet deeper than the body of the Holm Sand, which now occupies its place.

The leading mark for running through the new channel is to keep the Stanford Light Vessel bearing north half-east, or by day, a conspicuous white house recently built on Corton Cliff, just open to the eastward of the battery, and black boat-house near Lowestoft North Ness; this will lead in with 20 feet at low water, and a rise of 7 feet at ordinary springs.

It only remains to point out how this channel may simply and at once be made available for the general purposes of the extensive coasting trade that frequents this track; the Trinity Board have so liberally and so thoroughly buoyed the present channels, that only one buoy in addition will be required for the purpose,—merely a change in the disposition of those already placed; and here I should apologise for touching on a subject with which the Elder Brethren are so much more conversant, but as I am on the spot and have the whole subject so immediately before me, perhaps I may venture to suggest the changes indicated by the new buoys placed on the plan; it will be seen that they are simple, easily made, and involve no expense worth mentioning.

I should add, that a second white buoy will be required on the western edge of the inner shoal, and that ships should be cautioned against passing between the present buoy and the Stanford Light Vessel, as now placed, as it leads over 12 feet water. Indeed, I would suggest that this light vessel be moved about two cables' length further south; and be placed at the north spit of the Newcome, thus leaving a channel into Lowestoft south road, from the north, between her and the Inner Shoal. The N. W. Newcome Buoy also requires moving out to the westward.

In conclusion, I have to state that the drawing of the plan, and the whole of the examination of the channel, has been made by Mr. E K. Calver, master and assistant surveyor, in the boats of this ship, and I have much pleasure in calling your attention to the zeal and perseverance with which this officer has accomplished the work during the stormy weather of the last fortnight.

I am, &c.,

Captain Beaufort, R.N., Hydrographer, Admiralty. JOHN WASHINGTON, *Captain.*

HARWICH.

No. 271.

Evidence taken on the 18th Nov., 1845.

No. 271.

PORT OF HARWICH.—RIVERS STOUR AND ORWELL.

Examining Commissioner—Captain WASHINGTON, R.N., F.R.S.

Present:—The Mayor (P. W. FRESHFIELD, Esq.), G. DEANE, Esq., JOHN PATTRICK, Esq., JOHN SANSUM, Esq., H. RUNNACLES, Esq., C. SHARPE, Esq., F. HALES, Esq., E. CHAPMAN, Esq., Rev. G. BURMESTER, Rev. R. BULL, Lieut. CUDLIP, R.N., of H. M. S. Blazer; Messrs. COTTINGHAM, BOLTON, GROOM, R. BARNES, BILLINGSLEY, A. HAST, T. GEORGE, JOHNSON, DORE, JOS. PAIN, J. SAGOARS, BIRD, BURCH, &c. &c.

The body of the Court was filled with mariners, fishermen, &c.

[*The Admiralty survey of Harwich Harbour, made in* 1841, *and several old plans, were laid on the table.*]

EDWARD CHAPMAN, Esq., Town Clerk of Harwich—after verifying some accounts transmitted to the Secretary of State, said—I conceive that this Corporation have full powers over the whole Harbour of Harwich, by prescriptive right, confirmed by their charters. Those powers were first granted to the Duke of Norfolk in 1469, and afterwards transferred to the Corporation of Harwich. I consider the governing charters to be the 7th James I. and the 17th Charles II., and which gave to the Corporation all the powers belonging to the office of Lord High Admiral. This last-mentioned charter was granted for "the maintenance and preservation of the harbour." Formerly the office of an Admiralty Court was exercised by the corporation, but not of late years; I cannot assign any reason for its discontinuance, but it was certainly not from any doubt as to their authority. I produce some minutes of their proceedings to show that the power has been exercised, and, indeed, that point is undoubted. Under their charter the corporation have the power of levying dues of *4d.* and 1*s.* respectively for anchorage and groundage. Certain mooring-posts are also provided by them, for which 1*s.* each is charged to vessels using them; the corporation have the power to refuse their being used, although they never do so; they are on the public shore granted to the corporation by their charter, and they would prevent any other person from erecting posts there. In proof of their title to the shore I may mention that they have sold some portions of it to the Crown for the purposes of defence. They are also entitled to 1*d*. per ton upon coals, and 2*d*. upon the register of every vessel for ballasting; and there is a further charge of 1*d*. per ton on vessels unballasting upon their shores, under the direction of the Harbour master. The corporation annually incur expenses for the harbour, but the treasurer will probably be able to give a more definite account of them. In my letter to the Secretary of State I mentioned that there was a complaint on the part of this corporation against a power claimed by the corporation of Ipswich over the harbour, whose assumed boundary line is from Shotley Ferry in a south-east direction to Pole's Head, which line takes in the corner of the ship-yard at Harwich; they claim the right under their charter of taking dues from vessels anchoring or grounding within this line: the claim is constantly resisted by the corporation of Harwich; the commanders of vessels are constantly complaining of having dues demanded by two harbour masters, and they frequently have to pay both. The Ipswich harbour-master does not reside here; he has a deputy. It was only last night that a captain was complaining at my office of having dues demanded of him by the Ipswich water-bailiff after he had paid the Harwich officer. I have no idea of the amount raised by Ipswich from these dues, but they do nothing for the preservation of the harbour, either by dredging or in any other way whatever. In 1844 the Town Council of Harwich expended 100*l*. as an experiment in dredging the harbour, and, as Town Clerk, I was directed to apply to the corporation of Ipswich and the dock commissioners there to assist in it; but the answer from the former was—"they had no funds applicable to the purpose; and from the latter, after expressing regret at the circumstance, that "they had no funds at their command which they were at liberty to apply in the manner requested." Both, in fact, refused to take any share in dredging the port of Harwich.

The COMMISSIONER.—But is the wording of their charter similar to that of Harwich? and are the powers granted them expressly stated to be for the preservation of the port?

Mr. CHAPMAN.—They are; but they have never, that I am aware of, applied any money for that purpose. The Harwich corporation have done so constantly.

Mr. DORR.—I recollect their landing on the Essex shore being resisted thirty-five years ago.

Mr. CHAPMAN.—I am not aware of the Ipswich corporation ever having made any representation to the Admiralty or Treasury of the deterioration of Harwich Harbour, and, from conversations with members of that body, I do not believe they ever have. The Corporation of Harwich have been constantly endeavouring, by applications to Government and by their own funds, to improve the Port. From 1829 to 1845 they have sent up five Memorials on the subject, in none of which Ipswich has joined. Not only does their charter state that the dues levied shall be applied to the preservation of the Harbour, but such is the case in all other harbours with which I am acquainted. The 10th of Henry VIII. is the charter under which Ipswich claims powers. According to the Ordnance map the boundary between Essex and Suffolk is about the centre of the Channel.

The COMMISSIONER.—Then, if their charter states that their jurisdiction does not extend beyond the county of Suffolk, both the charter and map would agree?

Mr. CHAPMAN.—They would; and it would greatly curtail the present boundary claimed by Ipswich.

Harwich never claims dues for vessels anchoring in the Orwell or in the run of the Ipswich tide through the harbour Since our last memorial to the Treasury, Government have responded to it, and have taken steps for the restoration of the harbour.

[*An old map of the harbour was here produced and inspected.*]

Mr. RICHARD BARNES examined.—I have been treasurer for this borough between six and seven years. The annual amount received for ships anchoring and grounding in the harbour during the last three years has been has follows:—In 1842, 39*l*. 17*s*.; in 1843, 66*l* 2*s*.; in 1844, 66*l*. 19*s*. The difference between the income of 1842 and the last two years has been caused by the great increase of the cement stone trade. The money so received is expended in salaries to the harbour officers; in repairs of the Angel Quay, the New Stairs, and the West Street Quay; in shortening the breakwaters, &c. During the last three years a larger sum as been expended for these purposes from the borough funds than has been received from dues. In 1842 the sum laid out for the repairs of the Angel Quay alone was 61*l*. 13*s*. 7*d*.; and in 1844 the expenditure for the same purpose was 78*l*. 7*s*. 10*d* In the intermediate year of 1843, some small sums were expended for shorting the breakwaters, but the precise amount is not shown by the accounts. My accounts are laid before the borough auditors every six months, and are printed and published every year. The whole amount of the corporation income last year was 815*l*.; and from this annual income the expenses of maintaining the harbour are paid.

CHARLES STILES.—I am harbour master and water bailiff of Harwich, and have been so about five years. I take my instructions from the Mayor, and my jurisdiction extends up the Stour as far as Wrabness. My duty as water bailiff is to gather the dues, and as harbour master to see to the anchorage of vessels and maintenance of the mooring posts, quays, &c.; if any of them want repairing I report it to the Town Council, who give an order for the work to be done; I never prevent vessels making fast to the posts; we have no cranes on our quays, though we often have to land heavy goods; no quay dues are charged; the only dues are for anchorage, groundage, and using the mooring posts. Vessels cannot in a gale lie secure at the Angel quay; the worst winds for our harbour come from W.N.W. and N.W.; we are greatly in want of protection at these quarters; there is not even protection for fishing boats and wherries: I think a basin protected by a breakwater would be an excellent thing for us, but docks would be better; there is a good place on the Bath-side for making docks, and I am sure our fishing boats would be glad to get into them. I have no complaints to make of vessels throwing ballast overboard in wrong places; they generally go as far towards high-water mark as they can; I don't think that throwing ballast upon the ooze does harm, and I have given permission for ships to do so; I think it makes the mud firmer; I cannot say whether it is not likely to wash into the channel; it used to be thrown out opposite the Clerk of the Cheque's steps, till Capt. Deane, the then Mayor, found fault with it; and it is now discharged on the ooze above the town.

Capt. DEANE.—The corporation at one time requested very strongly to be allowed to lay ballast upon the Ordnance premises on the east side of the town, but the Commandant reported against it, and the application was refused.

Mr. COTTINGHAM.—A few years since there was a memorial from the inhabitants generally that ballast might all be discharged in one place, so as to make a ballast wharf, instead of throwing it out as at present in heaps, which are a great obstruction to the navigation. I should conceive there would be no difficulty in forming a ballast wharf here any more than in other ports.

Mr. CHAPMAN.—We have no compulsory power as to where it shall be thrown; we can only fine persons for discharging it in deep water.

STILES.—At present ballast is thrown about in all directions upon the Suffolk shore; but I never thought I had power to interfere there, as the parties tell me it is not in our jurisdiction.

I never knew the Ipswich water bailiff prevent ballast being thrown out improperly. Ballast used to be taken away from the lower breakwater on request with my consent; I thought it did no harm; but I was ordered not to allow any more to be taken away.

Appendix B.

Harwich.

No. 271.

Evidence taken on the 18th Nov., 1845.

We have oyster spat in our harbour, and used to have a great deal more than now, particularly about the Gristle and Shotley Ferry; I have many years ago seen 50 sail of smacks in the harbour dredging for spat, which they took to Brightlingsea. The Harwich people frequently grumbled about it, and thought that the Ipswich corporation, who claim that part of the harbour, ought to prevent its being taken away, but they did nothing in the matter; it is a great injury to the town, but I never have tried to prevent it, as I thought I had no power. If the spat was not taken away we should have oyster beds here, which we have not at present.

Captain Deane.—The reason why we have not tried to prevent it has been for fear of a law-suit. The Ipswich people charge 1*l.* a dredge in their river as low down as Old Shotley Hard.

Stiles.—The river Colne derives great benefit from this harbour at our expense. At the present time several vessels have been dredging here for mussels and five-fingers, which they have taken away in immense quantities to Brightlingsea, Merses, and other places for manure; this is also an injury to the poor fishermen of the town; we supply a good many fishing vessels with bait (wilks), of which we can get plenty off Walton and up the Stour; we take a good many pounds in this way; there are frequently 50 fishing vessels in this harbour at a time; a great many smacks fish off the Doggerbank, in the Wold, off the Ness, and the Galloper; if we had greater facilities for sending fish to London we should have more smacks here, because they would be glad to avoid the voyage up the Swin, which is difficult and dangerous and costs too much time; a railroad is what we want; at present fish can be sent from Yarmouth by rail at 1*s.* per pot, while the cost from here would be 2*s.* 3*d.* There would be no difficulty for vessels to get refitted here; we have an 80-ton vessel now on our patent slip; I recollect about 40 years ago a frigate being hauled up here for repairs; we have plenty of deep water in the harbour: the Conqueror and some of the largest war ships were built there; the only alteration in the state of our harbour has been caused by the taking of cement stone from the foot of Beacon Cliff; that has done us a great deal of harm; there used to be a ridge of rock there from 2½ to 3 feet high, which was a great protection; but now the tide in that part can hardly be rowed against with a four-oared boat; besides taking away this rock, great holes have been dug about 200 yards from the shore to get the stone. My duty as water bailiff is to gather dues from vessels coming to the east of the breakwater; I do not go to Bloody Point or Shotley Ferry; I have not been told what the boundary is; I go from old customs; in levying dues I frequently come in collision with the Ipswich water bailiff; yesterday I took 4*d.* for a vessel anchoring just off the end of the breakwater, and Lambert, the Ipswich deputy, afterwards went on board and abused the people for paying me; I believe he assulted the captain as well; the other day a foreign vessel, lying not more than 300 yards from the breakwater, paid Lambert 1*s.* 8*d.* for dues, and had afterwards to pay me, as he was within my bounds. I only charged 4*d.*; the masters of the vessels frequently complain of having to pay dues twice over. When Captain Deane was Mayor I received instructions from him for the sake of peace, to avoid any discussion with the Ipswich water bailiff which might lead to a law-suit.

Lieut. Cudlip—I was employed upon the Admiralty survey of this coast, and produce a chart showing the course of the Orwell and Stour currents through the harbour. They were measured on a calm day in the usual manner, by means of floats with anchors attached. We used one float to test the flood and two the ebb tide, and a boat followed them to note the direction taken by each. That with the flood tide passed as near as possible in mid-channel, and went into the Orwell; the second float was put overboard in the centre of the Stour, and went three cables more to the westward than the former one; the third was put overboard on the south-west side of the Orwell, close to Ooze End Point, and its course was close over to the Suffolk shore, within one hundred yards of the beach. The course of the ebb current was also tried from the Stour, and the float went as nearly as possible along the centre of the channel. I should have no difficulty in defining the natural limit between the two rivers. If the question of the jurisdiction of Harwich and Ipswich turned upon the dividing point in the set of the two streams through the harbour, there would be no difficulty in laying it down upon a chart.

The Commissioner—The charter seems to intend the ebb tide as the rule, for it speaks of the set of the tide towards the south-east. It is a question with me whether the fair stream of the river ought not to be settled at low water.

James Barter Pain, examined.—I was formerly deputy water-bailiff for Ipswich, and my duty was to receive money for vessels anchoring and grounding within the Ipswich boundary, which I considered to be a line south-east from Shotley Ferry to Pole's Head; that line came within the two breakwaters, the ships lying off the north face of the town. I frequently collected from vessels as close to Harwich as that; my charges were 1*s.* for groundage upon all vessels, but for anchorage English were charged 8*d.* and foreigners 1*s.* 4*d.*; there was also a charge of 3*s.* 4*d.* for vessels casting out ballast upon the Suffolk Coast, between Shotley Gate and Landguard Fort; they always discharged it as near high water mark as possible. I am convinced that the sand ballast was washed down into the stream of the harbour; I think Captain Deane complained of it once.

Mr. George.—When I was Mayor an information was laid before me by the Harwich water bailiff against some parties throwing ballast into deep water on the Suffolk side of the harbour, and they were convicted under an Act of George II.

Pain.—I do not recollect any other part in which ballast was discharged, except from Bloody Point to Shotley Ferry.

I once had a dispute with the master of a Pappenhurgh vessel who had the Act of Reciprocity on board, and would not pay more dues than English vessels; I took the smaller sum, being all I could get, and all vessels from that port have since paid the same; I never kept any exact account of money collected, but I sometimes took more than 5*l.* a month, and sometimes only 10*s.*; I collected from all vessels running into the harbour for shelter; I should think the whole amount of dues was more than 60*l.* a-year.

The Commissioner.—Do you know how the Ipswich corporation laid out the money?

Pain.—I don't think the money ever went to them; I think Mr. Jobson, the Ipswich water-bailiff, had that. He once told me when I was going to the Town Hall about a summons not to tell the Magistrates how much I collected, as if I did perhaps the Ipswich corporation would take it upon themselves, and only allow him a per centage. I am sure the water-bailiff never laid out any of the money upon the harbour; he's the wrong sort. I have had a great many quarrels with the Harwich water-bailiff about the dues; and I have heard many masters of vessels complain of having to pay two officers; they always wanted to know where Harwich harbour was. I never knew the Ipswich authorities do anything towards dredging or otherwise improving the harbour; I think in the Ipswich boundary, if it was well looked to, they would collect double what is done in the Harwich for anchorage. I should think the amount would be 100*l.* a-year, and some good easterly winds might make it up 150*l.* Easterly winds drive vessels into the harbour, and that is our harvest. Half what I got came to my share; but I had to find a boat and pay my expenses out of it. I had some other employment, and mixed the two up together. I always came as close to the boundary line as I could; I never had exactly the impudence to claim dues for a vessel lying upon the Essex beach, but I did not mind her tail being on the ground; if they would not pay I always threatened them with a summons, though I never took one out. I wrote to Ipswich a good many times about it, but the only answer I got was that "they were going to look after it." I fancied the reason why they did not take the matter up was because they knew they had no right here; I don't think that the Ipswich water-bailiff ever complained to the corporation; I think he was afraid to do so; my charges were frequently refused by vessels, and when I could not get the money I went without. The Ipswich

APPENDIX B

HARWICH.

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Evidence taken on the 18th Nov., 1845.

water-bailiff told me to take something from the vessel when the master would not pay, but I was afraid of the law; I think the worst quarrel I had was with Stiles. I took the office in 1837, and gave it up last May; one part of the time I collected for both Ipswich and Harwich, I could make the thing right then. I think I behaved honestly to both; I had nobody to dispute me, and I don't think I infringed upon either boundary, on one side of the line I took 8*d.* and on the other 4*d.*; I had not an eight-penny pocket and a four-penny pocket, but I kept separate accounts, and I think I divided them right.

THOMAS LAMBERT examined.—I am the present deputy water-bailiff for Ipswich; I take my instructions from this deputation [the document was here handed to the Commissioner]; my limits I take to be a line from Harwich Breakwater to Shotley Gate. I levy from all vessels lying to the north of that line; I do not go close to the line; any where within 300 yards is near enough for me; I charge 8*d* to English vessels for anchorage, and 1*s.* 4*d.* to foreigners: the charge for groundage is 1*s.*; there is no charge for discharging ballast, I have no power to interfere with that; if I saw vessels discharging ballast below high-water mark I should not think I had any business with them: I do not know how much the dues amount to in the year, as I have not held the office that time; all the dues together I should think average 1*l.* a month. All vessels belonging to Ipswich are exempt; and vessels I cannot get the money of I go without. (Laughter.) Part of my instructions are to take 1*s.* 4*d.* from foreigners. Vessels can get ballast from Landguard Beach, for which they pay the lord of the manor.

The COMMISSIONER.—The instructions you have handed in do not appear to go so far as you say. They define the liberties as extending from the port of Ipswich south-east to Pole's Head.

LAMBERT.—I had verbal instructions besides from Mr. Jobson. I sometimes come in collision with the Harwich water-bailiff; the other day I was threatened with a summons for taking dues of a vessel which they said was not in my boundary, that is just what I want, as I should then know how far I have a right to go; I do not want to do any thing which is not right.

The MAYOR.—Did you never hear of more than one Shotley Gate?

LAMBERT.—Yes, I have heard of Old Sholley Gate; a line drawn from that point to Pole's Head would go right into Ipswich waters. I think it would be a very good thing if this point could be settled.

If the master of a vessel refused to pay I should not summon him; my demands have frequently been resisted, but I have never applied for a summons; I had one this morning who refused to pay, I never take any thing by way of distraint; if they will not pay, I let them off. Half of what I get goes to Mr. Jobson; I believe it is a perquisite of his. I do not receive any money for ballast taken from Landguard beach.

Mr. COTTINGHAM.—I believe that the carelessness with which ballast has been discharged about the harbour has been very hurtful to it. I also think that if Government would allow ballast to be taken from Landguard Point free of charge, it would be a boon to shipping, and would prevent the point growing out farther.

The COMMISSIONER.—It might be taken from the extreme point occasionally, but as a general thing I could not recommend it; as it at present is, I think that point of benefit to the harbour if it does not farther out. If you can show that the taking it from Walton (Suffolk) Beach will be of public benefit it may perhaps be granted.

WILLIAM CHASER examined. I was formerly for seven years water-bailiff of Harwich; my instructions were to collect dues in Harwich harbour; the limits were a line south-east from Shotley Gate, which only left me a very small space to collect in; my orders were not to interfere with the Ipswich water-bailiff at all; I believe that was done merely for the sake of peace; one time I went rather beyond the limits, and had to refund the money; the Ipswich bailiff threatened me with a summons, and rather than go there I gave up the money; that was 1*s.* I had taken for a sloop lying just off the end of the breakwater; I used only to go just above the Glatton; the Ipswich pilots were water-bailiffs at that time; within my knowledge they claimed dues close in Harwich shore.

Capt. DEANE.—There has been a long disputed question between the corporations of Ipswich and Harwich respecting the boundaries of the harbour. In 1766, as can be proved by existing documents, there was a law-suit between the two corporations respecting some harbour dues collected within what was said to be the rights and liberties of Ipswich. I may perhaps take the liberty of premising that the rights of Ipswich as an Admiralty Court are pretty extensive; but it is well known that the rights of an Admiralty Court do not give them the power of taking fees for anchorage and groundage, but are confined to *jetsam*, *flotsam*, and *lagan*. It appears, however, that their rights as an Admiralty Court have been interpreted into the power of taking harbour dues. It was upon this ground that the law-suit took place, but, although the question was tried twice, the question was never brought to an issue. On the first trial a juror was withdrawn, and of course no verdict given; and upon an application for a new trial an observation was made by the Judge that if the cause were tried for ever it would never settle the question of boundary, because it was an action for money had and received. In this way the question has never been brought to a close; but that it should be settled I believe is the wish, not only of the Town Council, but the inhabitants of Harwich generally. I must confess that the rights of Harwich are not particularly defined in their charters; neither are those of Ipswich; but the charter of Henry VIII., said to be an explanatory charter, and to "remove all doubt and ambiguity," gives Ipswich the right to the run of water from their port south-east to Pole's Head. That right Harwich would never dispute, but would sign a mutual agreement to that effect, to prevent further disputes; and if you, Sir, as Commissioner, can devise any means by which the point may be settled, I believe it would confer a great benefit, not only on Harwich, but Ipswich also.

The COMMISSIONER.—I shall feel it my duty to report the whole of the circumstances fully to Government, and to lay this evidence before them.

Capt. DEANE.—There is one other matter which I wish to mention. In Mill Bay and further on towards the westward, the Lord of the Manor has claimed the right of digging up the cement-stone to the great injury of all who have property on that frontier, and ultimately, I fear, to the danger of the harbour. Unless this matter is seen to, I am afraid all that the Board of Ordnance is about to do in that quarter will be non-effective. The danger to the port may be distant, but it will be sure to come unless this practice is put a stop to. I believe there are gentlemen here whose property has been damaged to a great extent; but I am merely speaking now on public grounds, and I repeat that something must be done in this matter if our port is so continue a harbour of refuge.

Mr. PATTRICK.—A quantity of land on the south bank of the Stour, now called "Dock Marshes," was reclaimed about 30 years ago by Mr. Garland, the Lord of the Manor, to the extent, I should think, of about 300 acres, a certain quantity of which was allotted to adjoining freeholders. I never heard of any application being made to the corporation of Harwich for permission to make that enclosure; I think he did it from an impression of his own right to do so.

The COMMISSIONER.—What effect has the enclosure had upon the Ramsey navigation?—Mr. HALES. It has nearly destroyed it.

The COMMISSIONER.—Would the improvement of the navigation at that time have been a benefit to Ramsey?

Mr. PATTRICK.—Very great, undoubtedly; and I think it would have been more remunerative to Mr. Garland also. The only other enclosure that I know of is one made by myself at Dovercourt, about 6

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years since. when I enclosed 8 or 10 acres. I asked no permission of the corporation; I was losing my freehold on the opposite side, and I thought I had a right to have a bit there. My impression was, that I might, if I had been so disposed, have enclosed down to low-water mark. In 1817 I hired a mill and house near Beacon Cliff; but such have been the encroachments of the sea that I have now lost nearly all the land upon which those buildings stood; I consider that has been caused by the removal of the cement stone, and excavating for it in front of the cliffs. The Lord of the Manor, who claims the right of taking it, has been frequently remonstrated with by the inhabitants, but he has taken no notice of it. I have had men convicted in this hall for stubbing my freehold to get the stone; but I believe it is carried on to this day. There was formerly a ridge of stone several feet in extent, forming a natural barrier to the cliff; but it has all been taken away, and excavations made besides. I believe this has been done under the directions of Messrs. Francis and White, the cement manufacturers. I also occupy lands belonging to Capt. Deane, to which there is a sea wall: for the first few years it cost me comparatively nothing to keep up; but now the sea has, from the same cause, gained so much power there that I have been compelled almost every year to re-pile it. Unless something is done to stop the practice, Harwich must ultimately become an island.

Mr. COTTINGHAM.—I wish to mention the subject of a distinguishing light on Landguard Beach End. I am not a sailor myself, but I have had the testimony of pilots and mariners that it would be a great benefit to the shipping interest. A few days since a vessel coming over the Naze, running for this Harbour, could not see the Harwich lights over the cliffs, and kept too much away, the consequence of which was, her striking on the Cliff Foot Rock; whereas, had there been a red light upon the Beach End, she would in all probability have seen it, and prevented the mishap. I consider that the present leading lights of Harwich lead into danger rather than safety. We have now a life boat here, supplied by the Admiralty, and she is in good order and ready for use. Within the last few years there have been three wrecks requiring the assistance of a life boat. I consider our harbour is very useful as a refuge for ships passing on the east country trade. I have seen from 300 to 400 vessels in the harbour, and in one instance a ship of 1000 tons burthen.

It has been a very common practice for the Scotch and Hamburgh steamers to put in here from stress of weather. The winter before last the Dutch mail was repeatedly landed here, from the steamers not being able to get up to London. If the mails were landed here, there would, with a railroad, be every facility for their speedy transmission to London. To show the importance of Harwich as a starting point, I may mention that only last Sunday a large Dundee steamer, which left London the night before at 10 o'clock, got ashore on the Gunfleet, at seven in the morning, and was not got off till half-past ten. If, however, she had sailed from this port she would have avoided the dangers which befell her on her way from the Thames, and might have been at least 100 miles in advance of her position when she passed Harwich at 2 o'clock.

I think there is great want of a dock and breakwater on the north face of the town. I have seen the plan of the breakwater proposed to be erected, and I think it will afford sufficient accommodation to the town for some years to come. There is, however, a want of docks, and there is plenty of land which might be used for the purpose. Harwich is so surrounded by Government lands that it is scarcely possible for her to enlarge herself. I consider that the ground occupied by the cement factory, which was taken by the Government under the Defence Act, but which is not required for that purpose, might be given up for the benefit of the town. There is also Beacon Cliff, which might be let by the Government on building leases; and I have no doubt it would tend to promote a spirit of enterprise in the town which would be extremely beneficial. With regard to the port, there is every accommodation for the refitting of vessels; and if they require pumping out, I have purchased the patent right to a powerful machine, which has in several cases been found very effective.

The COMMISSIONER.—I will cheerfully bear testimony to the efficiency of the patent pump to which you refer, and I have much gratification in informing you that I found it the other day in use at Hartlepool; it would be a great benefit to shipping if its value were more generally known.

Mr. GROOM.—With regard to what has been said about spat, I think there might be a very profitable concern established in oyster beds in the Stour; they are a native brood, but the great obstacle is the want of a right to the soil to lay the oysters on, and power to prevent other persons dredging. I think from Shotley Gate to Erwarton Ness excellent layings might be found. An increase of shipping would not interfere with oyster layings, as they would be above the anchorage ground. I think a company might be formed by shares, and there is plenty of spat in the harbour. With regard to the fishery in general, I believe, if we had a railroad, the greater part of the North Sea fishing vessels would come in here, and send up their fish instead of taking them up the Thames. The present charges for carriage have been almost a prohibition to the cod-fish trade from this port. There is plenty of bait to be had here; and formerly we had 72 fishing vessels belonging to the port. That number is now very much diminished, I believe principally from the more influential inhabitants not embarking their money in it as a branch of trade. I consider that the port is just as eligible for the purpose as it ever was. I think there are at the present time 250 well-vessels fishing in the North Sea from the Thames alone, and most of them would come here if we had a railroad. That number does not include trawlers, of which there is a great number.

Capt. TAYLOR examined.—I am commander of the Desmond Revenue Cutter, and have been so two and a half years; it is quite true that the Harwich leading lights lead into danger. I find from my own experience that to be the case; my plan for remedying this would be to have a light erected on the Beach End: the present directions from the Trinity Board for entering the harbour are to open the lights about a sail's breadth; but if a vessel keeps on in that direction, she will run upon the Cliff Foot Rock; in the dark there is nothing to tell you when to haul up, and the distance is only from half to three-quarters of a mile; a vessel has only that distance, and nothing but the judgment of her pilot to guide her; the present Trinity Directions lead a vessel right on to the Cliff Foot Rock; this harbour is the constant resort of strange vessels, which frequently run in at night; and these stand much more in need of a light than those acquainted with the port, but I think it would be of general use; I think the wreck here the night before last was in consequence of the vessel coming in with the lights in one. I think the harbour is in one of the best positions for affording assistance to vessels getting upon the shoals; and succour can easily be sent to ships upon the Gunfleet or upon any of the outlying shoals; I think a light in the position described would also be of great benefit to vessels in passing over the Naze; the erection of the Cork Ledge Light by the Trinity Board has been one of the finest things ever done for Harwich harbour; I think we have plenty of buoys, and that they are in their right positions; there is an Admiralty Chart Agent resident here, and admirable charts of the coast, and a large plan of the harbour may also be had in the town.

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Correspondence of Board of Trade and Trinity House.

No. 272.

LONDON—RIVER THAMES.

[*Report from the Trinity Corporation to the Board of Privy Council for Trade, on removing Shoals and Banks in the River Thames.*

SIR,

Trinity House, London, 30th May, 1834.

I have to acknowledge the receipt of your communication of the 26th instant, signifying by direction of the Right Honourable the Lords of the Committee of Privy Council for Trade, that since

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the letter which I had the honour to address to you under date the 30th ultimo, their Lordships have been still more forcibly urged to consider of the means by which the shoals which impede the navigation of the river may be removed; stating also, that the complainants in this matter consider that this Corporation is bound to remove the obstructing matter, although the substance of it may not be such as is suitable for the purpose of ballast, because the removal of such obstructions constitutes the benefit to the public contemplated in the Grant of the Charter; and further signifying their Lordships' request to be informed of the ground on which the Elder Brethen consider they are not obliged to perform the duty which it is asserted by those parties falls upon that Corporation.

Upon the renewed consideration of this subject, and in especial reference to the point on which their Lordships desire to be informed, I have it in command to request you will submit to their Lordships that the Elder Brethren are clearly of opinion that the responsibility, which it appears is now attempted to be thrown upon them by the complainants in this matter, to remove all obstructing matter to the navigation of the river Thames, does not attach under existing circumstances to this Corporation.

By the Grant of the 36th year of her Majesty Queen Elizabeth, it appears that the "lastage and ballastage, and office of lastage and ballastage of all and all manner of ships, and other vessels whatsover coming and being upon the river of the Thames," &c. &c. were surrendered by the then Lord High Admiral of England unto Her Majesty, with a request that the same might be granted and confirmed to this Corporation, and Her Majesty was graciously pleased to grant and confirm the same accordingly, in the manner and for the sole purpose above-mentioned.

In the 17th year of the reign of King Charles the Second, the lastage and ballastage were granted anew to the Trinity House, upon a surrender of a previous Grant of the 15th year of that reign, consequent upon some doubts which had arisen respecting the same. In that Grant of the 17th year of his said Majesty, it is recited: "Whereas many decayed seamen, their wives, widows and orphans, have from time to time received good relief by the hands of the said master, wardens and assistants of the said Trinity House of Deptford Strond, out of the lastage and ballastage raised and taken forth of our said river of Thames, for ballasting of ships and other vessels;" and the lastage and ballastage of ships and vessels in the river Thames is then regranted to the said master, wardens, &c., for the uses, intents and purposes aforesaid; and in a subsequent part of the said Grant, His Majesty was pleased "to give unto the said master, wardens, &c., to and for the uses, intents and purposes aforesaid, the gravel, sand and soil of the said river of Thames, and every part and parcel thereof, for the ballasting of ships and other vessels."

The Elder Brethren forbear to occupy their Lordships' time with the recital of many other passages to the same effect, which are to be found in the said Grant, trusting that sufficient has been adduced to manifest to their Lordships, that the grant of the gravel, sand, &c., of the river Thames, and of the ballastage therein, was made to this corporation for the ballasting of ships and vessels; having for object, as is expressed in the said Grant, that the "gravel, sand and soil by them to be taken out of the said river, be raised, had and taken out and from such shelves and places of the said river, as are or shall be of danger to shipping in the said river, and for the bettering and more safety of the same;" and also, that the profits thereof should be applied to the relief of decayed seamen, their wives, &c., as before expressed.

The Elder Brethen further direct me to submit to their Lordships, that the opinion which they entertain upon this subject is confirmed by the subsequent part of the said Grant, wherein mention is made of the "better advancement of the said work of cleansing the said river, and the more speedy and effectual performance, perfecting and accomplishing of the same, so much tending to the benefit of the commonwealth," because especial means of defraying the charges thereof are thereby provided, altogether separate and distinct from the profits of the office of lastage and ballastage thereby granted, which are not made in any degree applicable to this last-mentioned purpose, but are reserved whole and entire for the objects of charity before mentioned. Those sources of revenue, if at any time applied to that purpose, have long since ceased to be so, and the Brethren apprehend could not at this time be in any manner rendered available thereto. But they desire me in conclusion to observe, that while they have been at all times desirous and ready to render the execution of the office they hold under the Royal Grant before recited available to the removal of annoyances and obstructions to the navigation of the river Thames, so far only as the materials of which they have consisted could be rendered available to the ballasting of ships, they are not in any degree desirous of avoiding any responsibility which can be justly considered to attach to them for the removal of obstructions of a different description, provided it shall be the pleasure of His Majesty's Government to place at the disposal of this corporation sufficient funds for that purpose, independent of the profits of the lastage and ballastage, as unquestionably appears by the terms of the Royal Grant to have been originally intended.

I have, &c.,

J. HERBERT.

Thomas Lack, Esq.,
&c. &c.

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Evidence of Admiral Sir George Cockburn, K.G.C.B.

No. 273.

Extracts from the Evidence of Admiral Sir GEORGE COCKBURN, K.G.C.B., *before a Select Committee of the House of Commons on the Port of London, 25th July,* 1836.

CHAIRMAN.—During the time you were at the Board of Admiralty, did you form an opinion that public inconvenience was experienced from the state of the jurisdiction exercised by different bodies over the navigation of the river?—Certainly.

When it was thought desirable to remove any shoal or obstruction, were there the means in the power of the Admiralty to do so?—No, certainly not.

Was there any public body whom they had authority to oblige to remove any such shoal or obstruction?—No, unless it were within a certain distance of our dock-yards, over which we had a jurisdiction, and exercised it so far as to do it ourselves, and of course to be paid for by the naval department; but if any serious evil had arisen in other parts of the river, we should have applied to the city of London, considering the Lord Mayor and Corporation to be the general conservators of the river.

Do you imagine that the city of London would have felt themselves bound to comply with any request to remove a shoal?—I do not know whether they would have thought themselves bound to comply, but my impression is that they would have done it.

Supposing that shoal had been composed of materials fit for ballast, would the Trinity-house have

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allowed the city of London to remove it?—That I am not able to answer; if the Trinity-house could have removed it, then we should have applied to the Trinity-house to have done it; but that is the inconvenience I alluded to, and I at once acknowledge that a great inconvenience does arise from having so many bodies having rights on the river Thames, with powers clashing the one with the other.

You think it very material that there should be some alteration of the law in this respect?—Yes, so as to have one body to have the whole charge, and to be empowered to go to the expense and take all the advantages.

Mr. WARBURTON.—Do you happen to know in what manner the Trinity-house raise the ballast; whether they use the improved means of raising it worked by steam-engine, or the ordinary mode of manual labour?—I believe, generally, they use the ordinary mode of manual labour; but if I recollect rightly (speaking now of three years back), I observed one vessel working by steam a little before I left England; one below Greenwich, where they generally take ballast. I am quite certain that if one power had the regulating of the whole river and the Port of London, it would be much better done.

You would remove all question as to where the responsibility lies?—Certainly; I would have the advantages and responsibility in one body.

Mr. Alderman WOOD.—In cases where you had communication with the Lord Mayor and City authorities, as conservators of the Thames, have you found in general attention to any representation the Admiralty have made?—Certainly, I must do them the justice to say they always have been attentive; but it must be obvious to every one, that if the Trinity-house say, we have the power to raise ballast, and you must not interfere with us; another body can say, we are laying down mooring-buoys, and nobody shall touch them, except under our authority; and another party say, the king's interest requires a shoal to be removed here, and if nobody else will do it, we must do it at the public expense; that is a state of things most objectionable; it certainly therefore should be known in whom the power to remedy these things does really exist; and I am satisfied it would be of great advantage to the trade of London if the exercise of the whole power upon the river were placed under one known responsibility.

Mr. WARBURTON.—Have you considered in what hands it would be best to place that undivided authority?—I should not like to answer that question off-hand; I think that is a very large question, and it would be necessary to have full information regarding the original rights of the City on this point before answering a question of this description.

No. 274.

Extracts from the Evidence of Captain BEAUFORT, *Hydrographer to the Admiralty, before the same Committee.*

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Captain Beaufort's Evidence.

CHAIRMAN.—Do you consider the navigation of the Thames to be in a satisfactory state?—Every day's experience convinces me more strongly of the necessity of having the preservation of the Thames navigation committed to the guardianship of some active, impartial, and permanent Board, such as the Admiralty or Board of Trade, who know what regulations should be made, who would have power to enforce them, and who would appoint proper officers in different parts of the river, not only for that purpose, but to detect any encroachments from the shore, or any accumulation of gravel or mud in the bed of the river.

Do you think that if proper control had been exercised over the river, its navigation would be in a better state than it is now?—If such Board had been appointed to take care of the river, some wholesome system for its navigation by the different kinds of craft would have been adopted; the disgraceful nuisances of projecting jetties would have been prevented, the landing places and hardways which were absolutely necessary, only would have been allowed, and they would have been kept within proper limits, instead of the pernicious practices of their following out the low-water mark as the banks advance; the pier at Gravesend would never have been brought into the House of Commons, the recently proposed pier at Greenwich or Deptford (which, it is said, the City countenanced), would never had been thought of, nor would the floating piers there have been suffered.

How would the growth of shoals in the bed of the river have been prevented if a proper vigilance had been exercised on the shores?—Because this Board would have steadily employed proper craft and proper machinery, under the direction of a competent engineer, to remove the first deposit of gravel or mud; secondly, by breaking up the indurated crust of those ancient shelves or banks which are so strongly bound as to have resisted the action of the stream; and, thirdly, by continually taking the mud away from the extremities of the hardways, in order to lead to their gradual reduction both in length and height.

Have the operations of the Trinity-house had a useful effect in lowering the banks where their ballast lighters work?—Certainly; but not half as much as would have been the case if those operations had been conducted under one steady system. The Elder Brethren of the Trinity-house are well disposed to impove the navigation of the river, and have always given the most ready attention to every application to them on that subject; but still the raising ballast is an affair of profit, and wherever gravel or shingle can be procured with the greatest facility, and at the least expense, that is, on those parts of the bank where they lie most high and most loose, and where the least waste occurs, there the ballast people are, of course, most disposed to work; and as some parts of a bank are more convenient for working than others, the consequence is, that the surface is very unequally ploughed, and that the hollows are soon filled up again by fresh deposits. Whereas if their operations were carried down to a certain gauge, that is, if one foot, or two or three feet, were removed throughout the whole bank, the fresh materials swept down the river would pass on, and settle further out every year.

The Trinity-house, then, never remove the mud or other substances which will not serve for ballast?—No; nor under the present system would it be expedient that they should be obliged to do so, because the men who are accustomed to any one pursuit will always perform it better and quicker than if engaged in other occupations; and, therefore, for the removal of those useless materials, other hands should be employed; but, certainly, the general superintendence of all such operations should be vested in some public and responsible authority, who have no other objects in view than the efficient conservancy of the river navigation; not as a mere collateral occupation, but as a duty in itself of infinite importance.

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Do you conceive that the difficulties in the river to navigation on account of shoals are on the increase?—Captain Bullock's recent survey being the first that was ever made of the Thames, it is impossible to speak with accuracy of the changes which have taken place; but as nature works on the same principles here as in every other river of the world, by continually bringing down fresh materials from the interior of the country, there must necessarily be a tendency in the shoals and deposits to increase, unless counteracted by a constant series of uniform and judicious measures.

Mr. WILLIAMS.—You have spoken of projecting jetties being made, to the interruption of the navigation; are you aware of the fact of permission for constructing those jetties being given, and if so, by whom?—I believe the City, the present conservator of the river

Are you aware that they receive sums of money for those jetties?—I am not aware of that.

You state that the Trinity-house are always ready to improve the navigation of the river; do you find that the corporation are always ready to render them a helping hand in the improvement of the navigation?—I cannot say that they are not; but I do not know of any instances in which they have assisted them. In my official duties I have never had any correspondence with the City; but with the Trinity-house I often have.

No. 275

Extract from the Report of the Commissioners on Municipal Corporations, Sess. 1837.

No. 275.

Memoranda respecting the Conservancy of the Thames, and the Conflicting Rights and Authorities connected with its Management.

EXTRACT from the REPORT of the COMMISSIONERS on MUNICIPAL CORPORATIONS, Sess. 1837.

THE navigation of the River Thames, to which the empire owes so much of its greatness, raises another most important question. In the first place, the inhabitants of every quarter of the town might reasonably require that the privileges of ownership and conservancy, as they are called, should not continue to be confined to one district, to which they were granted when it, in fact, constituted the whole Metropolis; but, further, it is plain that the proper management of the port and river is not a matter which concerns solely the inhabitants of the Metropolis. The inhabitants of other parts of Your Majesty's dominions have a right to ask whether these functions, the due performance of which is of vital importance to all, are properly within the province of any local municipality, however extended; and why they should not be under the direct control of the general executive Government of the country.

The Courts of Conservancy appear to be of little practical use, and they involve an expensive and inconvenient machinery. The objects of the Courts, viz., the proper regulation of the navigation of the river, and the preservation of the fish, are less defectively attained by the superintendence of the Navigation Committee. We do not mean, however, by this statement, to imply any opinion that the Navigation Committee is a proper body for exercising such authority.

No. 276.

Walker, on the proposed Embankment of the Thames.

No. 276.

Report of JAMES WALKER, Esq., *Civil Engineer.*

SIR, *Great George Street*, 13*th Dec.*, 1841.

The object of the survey which, in company with the City Solicitor, Captain Bullock, R.N., Captain Fisher, R.N., principal Harbour-master, the Water-bailiff, and Mr. Leach, Clerk of the Works, I have made of the Thames between the London Stone at Staines and Gravesend has been to enable me, with the co-operation of the above-named gentlemen, to point out a remedy for the present defects of the river, in respect to navigation, as well as to salubrity and to the comfort and convenience of the inhabitants and owners of property of its banks.

During the thirty years that I have known the river, and have been professionally employed upon some of the principal engineering works on its shores, I am not aware of an inquiry to the same extent, then or at any former period, having been gone into; although the evils existing in the river have been long felt, and partial measures have been adopted for their removal.

The first of these was immediately after the fire of London in 1666, when Sir Christopher Wren proposed the construction of a commodious quay or open wharf, from Blackfriars to the Tower; in consequence of which an Act was passed in 1668, to prevent the erection of buildings within 40 feet of the river bank between the Tower and the Temple, so as to leave an open space called the "Forty-foot way;" which Act, having been in a great degree rendered nugatory by encroachments, was ultimately repealed in 1821.

The next public measure of the kind was in 1767, just a century after Wren's proposal; when, in connexion with the completion of Blackfriars Bridge, the frontage to the river, from Paul's wharf up to and including the Temple gardens, was embanked, under the direction of the late Mr. Mylne, the architect and engineer, in a straight line of half a mile in extent, at right angles with the bridge; the object being, as stated, "to remove the accumulation of mud, filth, and rubbish from the city side, which had rendered the wharfs inaccessible even at high water, was extremely offensive, and, in summer, often dangerous to the health of the neighbouring inhabitants." This measure, although partial and limited, is the greatest modern embanking improvement that has been accomplished on the river Thames.

In 1770, the proposal for embanking 100 feet into the river, in front of the space then called Durham Yard, now the Adelphi Terrace, was effected by Messrs. Adam, under an Act of Parliament, which, for reasons now difficult to discover, was strenuously opposed by the Corporation of London in every stage.

Amongst the various schemes for improving the port of London which were proposed at the end of the last and beginning of the present century, there were several for altering and amending the course of the river. Of these, one was a plan for wharfs and warehouses, by Mr. Jessop, then at the head of his profession in this country as a civil engineer; another was by Mr. Ralph Walker. Reports were also prepared by Mr. Mylne, Mr. Dance, Mr. Reveley, and other architects, which, with the reports of committees thereon, were printed. These inquiries at that time terminated in the formation of the

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West-India, next the London, afterwards the East-India, the Commercial,* and, lastly, the Saint Katharine docks; but the river below bridge has, with some few exceptions, been left untouched.†

Mr. Telford's Report of 1823 referred chiefly to the probable effects upon the river by the removal of London Bridge.

The Report of Sir John Rennie and Mr. Mylne, on the construction of a new line of quays along both shores of the river, between the bridges of London and Westminster, was made in 1831; and, in the following year, Mr. Scott and Mr. Firth presented a Report containing a concise historical account of the proceedings in reference to the river during the two last centuries, from which I have taken the above statement of the Act of 1668, and the improvement of 1767.

Last year I had the honour, as you are aware, to be selected by the Treasury, the Commissioners of Public Works, and the Navigation Committee of the Corporation of London, to report and estimate on embanking the river between Vauxhall and London bridges. This became a subject of inquiry before a select committee of the House of Commons. The evidence I then gave has been printed by order of the committee; it contains my opinion of the defects and means of improving that part of the river; also, a copy of the two reports before referred to, together with the objections to the scheme, elicited in the way of questions put to me chiefly by one of the members of the committee. A reference therefore to the examination before that committee will be found useful in the present inquiry, and probably interesting.

But the object of the investigation now on foot is even more extensive, embracing the whole length within the jurisdiction of the Lord Mayor, from Staines nearly to the mouth of the Thames, a distance of upwards of 75 miles, with London near the middle of it.

It is to this middle portion, namely, between Chelsea and Barking Creek, a length of 16 miles, within which is comprehended the whole of the metropolis and the docks and public works connected therewith, that our attention has been principally directed. Mr. Leach's report embraces the part above Chelsea, which concerns the upper navigation; and there is comparatively little to remark upon the part below Barking Creek, except in respect of the shoals to which I shall refer, and the lines for embankments which are shown upon the plans.

The subject is very important, whether considered in reference to the commerce and shipping of London, with its extensive docks, and the country around and above it, or as the great drain of a very extensive district, calculated at about 6,000 square miles, including the first city in the world; and therefore affecting the health, wealth, and comfort of millions of human beings.

Without going into difficult questions as to the changes that may have taken place in the direction of the main stream of the river, it is evident that great labour and skill have been applied to confine it within its present banks, which, from London to the mouth of the river, a length of 40 miles, are chiefly artificial. The probability is that, gradually, as the embankments were raised, the ground at the back of them became higher by the deposit consequent upon the diminished action of the waves upon it; and that the creeks and irregularities filled up: notwithstanding which, the marshes are still from 6 to 7 feet under the level of an average spring tide, and 9 or 10 feet under the highest tides. One of these tides, that of the 18th of October, 1841, the highest recorded during at least half a century, rose 3 feet 6 inches above the Trinity standard of average spring tides marked upon all the bridges, and was 10 feet above the level of the low marshes; so that, if the artificial embankments were cut through, the Thames would, at the very next tide, take possession of the large space which has been so long abstracted from it, and would be generally five times its present width. To watch over and prevent such a calamity, which would entail very serious loss of life and property, is the duty of Commissioners of Sewers, to whom juries of the counties make presentments, and through whose care breaches in the banks are of very rare occurrence; the last of great moment having been at Dagenham, nearly one hundred and forty years since, the stopping of which, by Captain Perry, was probably the most important work done in the Thames in the course of that century. During the thirty years that I have been engineer to the Commissioners for the part of the river extending from London to below Dagenham, a distance of from 20 to 30 miles, no breach of any consequence has taken place.

History, I believe, affords no trace of the time when these embankments were formed: the probability is that they are the work of the ancient Britons, under Roman superintendence. That they are the result of skill and bold enterprize, not unworthy of any period, is certain.

As these banks, and the oldest erections upon the river, are suited to the present level of the water, there are no sufficient grounds for supposing that the tides up the river now reach a much higher level than when the embankments were formed. But if they do, it must be caused by the tides at sea being higher than in ancient times; for it would be unreasonable to suppose that, when the river extended to the foot of the rising ground on the Kent and Essex sides, the tide would not attain a considerably higher level at and above London than it did at the entrance of the Medway, from the great width of the mouth and form of the river, or rather estuary, at that time.

At present the level at high water at London Bridge is two feet higher than at Sheerness,‡ a length of 40 miles: and at London Bridge it is, on the average of a series of observations,§ when the river was free from land floods, one foot lower than at Richmond bridge, which is 16¼ miles above London Bridge, and only 1¼ mile below Teddington, where the first weir is placed across the river; high water at Richmond being thus three feet above that at Sheerness.

The high water level is not, of course, attained throught at the same instant of time. The difference of the times of high water at these places is about two hours each; that at Richmond being two hours later than at London Bridge, and at that bridge, on the average, two hours later than at Sheerness.

Whilst old London Bridge stood, the regular inclination of the surface of the water was disturbed, there being a "step down" of from 6 to 18 inches, varying according to the strength of the tide at high water, and caused by the obstruction which the massive piers and starlings of the bridge presented to the flow of the tide.

But, although the artificial embankments have not produced much effect upon the positive height of the surface of the water, at either high or low water, they have, by contracting the width, undoubtedly done much to increase the depth under low water of the part between the banks, and thereby to improve

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* The Greenland dock, now one of the Commercial docks, was constructed in the 17th century.

† The principal work within my recollection is the removal, by the Conservator of the river, of a dangerous rock of concreted gravel from near the entrance of the West India docks, called the Blackwall rock, at considerable expense, about thirty-five years since.

‡ Mr. Lloyd's levels, published in the Transactions of the Royal Society in 1831.

§ The observations were made in 1823, previous to the removal of Old London Bridge, under the superintendence of Mr. James Mountague and Mr. Leach.

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the river for an extent of navigation for which, in its natural state, it would probably have been quite unfit, from the want of depth and from the uncertainty of the channel. This deepening has been effected by confining the current downwards of the land or fresh water, united with the tidal water, to act upon a limited width instead of being diffused, and its force spent over a great surface: thus its velocity and scouring force have been increased, and the channel has been deepened.

An illustration of this principle has been afforded in our own time in other rivers; in none, perhaps, so much as in the river Clyde, which, chiefly from the operation of contracting the width, has, from having a depth at Glasgow only for boats and barges drawing from 2 to 5 feet water, at spring tides, become, all within the last eighty years, navigable up to the quays for ships drawing from 13 to 16 feet, with full cargoes from the East and West Indies, and elsewhere.

I name the above to show that, although the river Thames has numerous imperfections, there is, in its great outlines, much to admire, and that even its apparent defects ought to be treated with caution; and I wish not to be understood to say that the narrowing or embanking has improved its sea entrances, or at all lower down than where the embankments were formed; on the contrary, by diminishing the back water, their effect below has been injurious.

As respects its fitness for trade, we have, with the exception of some shoals to be afterwards referred to, a depth of from 12 to 14 feet at low water,* nearly up to London Bridge; and a width nowhere of less than 700 feet; but generally 1000 feet at high water near London, a distance of 40 miles from its mouth.

As respects salubrity, it is to be observed that, in addition to the river or fresh water, which even as high as Staines, 37 miles above London, is very seldom less than 150,000 cubic feet per minute, and is much increased by the streams which afterwards join it, and still more by the springs which rise up under it in its course downwards, there is also the very much greater volume of tidal water, rising and falling in every twelve hours from 14 to 19 feet in vertical height, in constant motion, at a speed of from 2 to 3 miles per hour, carrying past London upwards of 70,000 tons, or from 2½ to 3 millions of cubic feet of water at every minute of time. Even the defects which are at present apparent, and so much require removal, arise in a great measure from the altered state of things at the end of perhaps fifteen centuries from the time when the Thames was embanked, rather than from the ignorance of the engineers who at that distant period had the direction of this great work. Could they have contemplated that, on a length of only five miles, there would be placed upon its banks a city containing two or three millions of human beings, whose only drain would be the Thames, and that the citizens would invent and adopt luxuries in their houses which should discharge every kind of impurity into sewers and drains, to be built in every street and alley, and which should all empty themselves into the river, more care would probably have been taken to equalize its channel, and so to contract the width at these densely peopled portions, as to prevent the nuisances now justly complained of. Or, had they anticipated that lower down, at Woolwich, a great establishment would be formed for building and repairing ships of war, to float which thrice the depth of water sufficient for their largest vessels, with a river wall, certainly not in the best direction for the tide, would be required, they might have kept the embankments above and below Woolwich in straighter lines, so as to have induced a stronger current, and to have prevented the troublesome accumulation of mud in front of that national establishment.

It is to be noticed also that the clumsy erection of London Bridge in the twelfth century much disturbed the uniformity of the river, as left by the original embankers. Its eighteen piers with starlings, each from 30 to 50 feet in thickness, reduced the width of the water-way from 920 down to 300 feet, and the sectional area in nearly the same ratio; and this small water-way was further interrupted by nine of the openings having the wheels of the London Bridge water-works before them. These erections, increased by the stone that was, from time to time, thrown in the openings and round the piers, to prevent their being undermined and the bridge being carried away, acted as a solid weir or dam in diminishing the scour of the river, and causing an accumulation of matter above the bridge. Hence, not only the high water difference to which I have referred, but also a much greater difference at low water; for, when the tide was out, the water above the bridge was prevented ebbing so low as it did below the bridge by from 3 to 5 feet; whereby the quantity and strength of the tidal current were lessened, and the solid bed or channel of the river above the bridge was raised from 8 to 10 feet higher than below it.

This great evil is now removed; the present new and elegant fabric, designed by the late Mr. Rennie, and executed under the direction of his sons Messrs. George and Sir John Rennie, which was opened in 1831, has a water-way of 690 feet in width, with a great increase of depth under the arches; the whole channel of the river above bridge has since, from the increased current, been gradually lowering. Hence, already has it been found requisite to support, by piling round (within coffer dams, formed at great expense), the piers of Blackfriars Bridge, the water-way of which is 780 lineal feet; and the like operation is now in progress, also under our (Walker and Burges's) direction at Westminster Bridge, built by Labelye in 1740, of which the water-way is 820 feet. The piers of Vauxhall Bridge, which was built under my direction in 1816, are, with one exception, carried down to the London clay, and are not therefore likely to be undermined.

What has thus so soon been rendered necessary for the bridges upon the river will probably in time be required for the buildings on its sides. When it is considered that the bed of the Thames at London is generally gravel with a large mixture of fine sand, for a depth of from 10 to 14 feet under low water, where the London clay is reached, it is manifest that this point has not yet received the attention it deserves; nor will it, probably, until its effects become visible upon some public or other important building. Much was said on this head in my evidence before the Select Committee of last year, which it is unnecessary to repeat here.

Dismissing, however, the subject of the buildings for the present, the ancient embankers of the Thames appear to have done their work so well that, notwithstanding the great increase of traffic, little has been subsequently effected to improve the navigation of the river below Fulham Bridge, which is eight miles above London. Above Fulham, absolute necessity appears to have demanded an improvement for passing the barges. It was not, however, until 1777 that power was given to raise funds even to make a horse towing path and to remove shoals; and still the navigation remained very imperfect until after the year 1810, when an Act was passed empowering the Conservator of the river to erect locks, weirs, and other works, and to collect an additional toll upon the traffic, whereby a very great improvement has been effected under the able superintendence of Mr. Leach, who has directed the execution of all the locks and repairs done under the Act of 1810.

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* This low water is that of 17 feet 10 inches under the datum high water of Trinity standard; both determined by that corporation in 1800. The high water is marked upon the entrance of the London docks, and upon a pier of each bridge in the river.

The Lord Mayor, as Conservator of the Thames, through a Committee of the Corporation of London, interferes to prevent encroachments and nuisances for the whole of the district between Staines and Yantlet Creek, which is a few miles above the Medway. The Corporation of the Trinity House, under their charter, raise gravel between London Bridge and the main sea for the ballasting of ships; and thus, if fit for ballast, but not otherwise, the shoals are removed, the object being to combine the supply of ballast to shipping with the improvement of the river. Above London Bridge, gravel and sand for repairing roads, making foundations and other purposes, are raised by permission of the Lord Mayor as Conservator of the Thames, and individuals thus authorized take such materials wherever the quality suits them, without sufficient regard to the improvement of the navigation. The Commissioners of Sewers for the City form and enlarge their outlets into the river, to discharge the mud from the streets and the contents of drains into the river; and the Commissioners of Sewers and Embankments, for the level or marshes below London, support their embankments and sewers, to prevent the Thames from overflowing the banks and to carry off the rain water through the sluices which enter the river; but, if a part of the river is too wide, causing a shoal in the middle and mud banks at the sides, both probably the effects of too great width, I am not aware of any power with sufficient disposable funds to remove the shoal, or to narrow and straighten the river, even where there would be no private interest opposed to it. I am sure, at least, that very little indeed has been done in this way: and it is not therefore surprising that, from the alterations occurring in so great a lapse of time, there should be many things requiring attention and improvement. To state these, and the manner of effecting them, is the matter now to be considered; and when I say the manner, I refer only to my own profession, the engineering part, without any reference to legal powers and authorities, which I leave entirely in other hands.

Mr. Leach's Report states the defects and desiderata from Chelsea Bridge upwards, and the obstructions caused by the awkward positions of the bridges, and the small openings between the piles or piers. These bridges* are indeed altogether unworthy, as respects utility and appearance, of the situations so near London which they occupy. The following suggestions are directed chiefly to the part from Chelsea Bridge downwards.

The greatest defect in the river is the irregularity in its present width and depth; and in the line of the wharfs and banks that form its sides. As examples, the width half a mile below Fulham Bridge is 820 feet.

Two miles lower, or half a mile below Battersea Bridge, it is 745 feet.

One mile lower, opposite the Chelsea waterworks, 1000 feet.

One mile and a quarter lower, opposite the Penitentiary, only 600 feet.

Three quarters of a mile lower, opposite the Houses of Parliament, before the new river wall was built,† it was 1030 feet, and now is 924.

Half a mile lower, opposite Hungerford market, 1450 feet, which is nearly two and a half times the width opposite the Penitentiary.

Three quarters of a mile lower, below Brackfriars bridge, 995 feet.

Three quarters of a mile lower, below Southwark Bridge, it is contracted to 720 feet, just half the width opposite Hungerford market, which is one mile and a half higher.

The irregularity is less below London Bridge, with the exception of the contraction to 770 feet opposite Limehouse-bridge dock, three miles below London Bridge; so that the great inequalities are chiefly in the wharfed part at London.

Now, on reference to the accompanying plans, and the table of widths and observations appended to this Report, it will be seen, generally, that where the river is narrow, there it is deep and comparatively clear of mud, excepting where the bends divert the strength of the tide to one side; but where the width is great, there are shallows and muddy banks, which are injurious to navigation and to health. A main object, therefore, is to take means for removing these evils by an approximation to an uniform width and depth; and, with the exception of the cases where the shore between high and low water is used for coal barges and floating timber (for which a special provision can be made by recesses or docks, as is hereafter referred to, but explained more particularly in the evidence before last year's Committee), it is generally the interest of the owners of the particular property, as well as of the public, that they should be removed.

One of the causes of the present great irregularity upon the shores of the river, even where embankments have been formed in modern times, has been the want of a general system or plan for guiding the lines of wharfs and embankments; so that each party has proceeded either without authority, or the Navigation Committee has granted or withheld the authority, and defined the line, as the applying or opposing party had the stronger argument or interest, without having more before them than limited information of the part of the river which was proposed to be embanked. Thus necessarily, although often with the best intentions, sanction may have been given to what was injurious, and resistance offered to what would have been beneficial, to say nothing of the effects of private interest and influence operating in the same injurious manner, where the Committee, of which all the members were not likely to be conversant with such matters, had no general guide before them, and where the duties of the Conservator were therefore discharged with difficulty and uncertainty.

The plans now presented are intended to supply in some measure the above defect. They extend from Putney Bridge to Gravesend.‡ In the portion between Putney and the river Lea below Blackwall the proposed river lines are marked, which, after our survey and consideration, we concur in deeming as regular as circumstances will admit, and therefore as advisable. We reserve the right of correcting any errors. In the portion above Vauxhall Bridge we have conferred with the parties principally interested. Between Vauxhall and London bridges the lines are, with some partial and local modification, the same as I proposed, and which formed the subject of the inquiry before the Select Committee of the Session 1840.

Between London Bridge and the river Lea, the lines where wharfs at present exist are not such as to admit of great variation, and, from my knowledge of or professional engagement with the owners of the parts that are not yet wharfed, I do not anticipate any great objection.

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* Chelsea Bridge and Putney Bridge.

† The new Parliament wall is in the line of the proposed embankment on that side.

‡ The plans appended to this Report, numbered 1 to 7, extending from Putney to Woolwich, have been reduced from the large survey plans which accompanied the Report to the Committee, and are deposited in the office of the Town Clerk, Guildhall.

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The line from the Lea downwards to Barking Creek is laid out with particular regard to the effect of removing the nuisance caused by the mud opposite Woolwich dockyard, and the shoals in the navigation, the worst in the course of the river. To effect the improvement suggested here, of straightening the channel of the river by the removal of the quick bends above Woolwich on the Essex side and below Woolwich on the Kent side, would be a public work of great labour and cost, in which the Admiralty must feel a strong interest, the means heretofore taken to effect this important object not having succeeded; nor any similar measures which do not increase the velocity of the tide close to the wharf wall likely to do so. In stating this I do not wish to be understood as saying that nothing less than the alterations here proposed in the course of the river will effect the object; and I beg to add that caution is, at the same time, required to avoid producing a velocity which might be inconveniently rapid.

In an extensive measure of this nature a general agreement of the owners of premises to extend at once to the recommended line is not to be expected, although for the public reasons I have stated, as well as on account of the addition to the extent of property, and getting rid of the banks of mud which effect so injuriously the beauty and healthiness of the houses abutting upon the river, the probability is that, even supposing the extension to be optional, the applications for licences will be numerous, if parties know how far they may extend. To prevent doubt and all suspicion of partiality, the line throughout, with the terms and conditions, should be defined, and made generally known; and if the value set upon the acquired ground (as was done where the Blackfriars embankment was made) be understood to form a fund to be exclusively appropriated to the purpose of improving the river, the amount would generally be contributed without grudging.

One of the improvements to which I refer, and for which the funds will be applicable, is the reduction of shoals, where they consist of a material like silth and clay, the value of which will not pay for the removal. In the works of Blackfriars and Westminster bridges a surface of this nature, lying over the gravel, has been met with; but, after this surface was removed, the gravel under it was taken up without charge to the city or the Commissioners. It will be essential, in the removal of shoals, not to go under the regular level, but to leave the bottom, at a proper and uniform depth, with a well-defined navigable channel in the middle, gradually become shallower towards the sides.

When the scheme for embanking between Vauxhall and London bridges was before the Select Committee of the House of Commons in 1840, the question of the work being optional with each individual, or compulsory as a general measure, had not been decided by the Crown or the City. I was asked as to the accommodation to be given to those trades for which the sloping shore would be preferable to an embankment wall, and I stated that for such the shore might be left as at present, but that the outside (which would be in the line of low water and of the adjoining embankment wall) would have to be supported by close piling, of which the top would be level with the present bed of the river, to prevent the ground between this piling and the shore from drawing down towards the middle of the river by the deepening of the navigable channel. I explained that, where it was not the wish of the individuals to have an embankment wall, the portion of the river in front of their premises would thus form docks or recesses for coal and timber craft, &c. The sections, printed and appended to that Report, illustrate this,* and in the execution of which I cannot now see any difficulty; but, on the contrary, I think that barges and timber would generally be more conveniently placed in the recesses or docks than in the stream of the river. Queenhithe dock is an illustration, where the expense of keeping the mud down to the proper level is very small. The plan of dwarf-piling the sides, removing the sharp turns and the shoals, and regulating the depth, has been adopted, under my superintendence, in the river Yare, between Great Yarmouth and the sea, and has much improved that navigation.

It is, however, almost impossible to do a great good without producing a small evil, or at any rate without raising an objection; but I have no hesitation in saying that, whether compulsory or voluntary, the uniform new embankment and deepening would be a great public and, generally, a private benefit. It would be discreditable that the irregularities in the present bottom of the river above London Bridge should be suffered to remain, when the immense importance of the navigation is considered. These irregularities have increased, as well as become more apparent, since the removal of old London Bridge, which has lowered the water above and near the bridge 4 or 5 feet; the effect lessening as the distance increases, the decrease in depth at Westminster Bridge being from 2 to 3 feet.

The conveyance of passengers by steam-boats is a new feature in the river, which has in a few years become a matter of great magnitude, and one requiring attention. As they must land and receive their passengers at all times of the tide, and as they cannot come to the shore of the river, or to any wharf, at low water, various contrivances of platforms, floats, &c., chiefly of a temporary kind, have been carried out to them. If the wharfing or embankment were extended, these expedients would, with few exceptions, be done away with. In most cases a float alongside the wharf, with steps to accommodate the various levels of the tide, would be sufficient, as at the Brunswick iron wharf, near the East India docks, which was made under my direction eight years since, and also at the new wharf at Greenwich, finished last year under Mr. Martyr's superintendence. There may be cases in which this cannot be immediately effected; but it is undoubtedly desirable to avoid all irregular projections of piers; and, where allowed at all, they should be considered temporary, and subject to removal when they can be conveniently dispensed with, and should be placed under proper superintendence as respects construction and future use. To improve the landings, and to terminate the disputes and inconvenience which have been created by these irregular encroachments, run out for the want of something defined and permanent, will be important objects gained.

To the owners of the passage steam-boats, as well as to all watermen and lightermen, the deepening and equalizing of the river will be of immense importance in preventing the damage and obstruction which they sustain by the shoals; in this all I have spoken to agree. There was, I think, evidence to the same effect before the Select Committee of Parliament in 1840. A small rate per passenger, to be applied to the improvement of their course and its termination, would, like the tolls upon the turnpike roads, be more than compensated for by the resulting advantage.

Various schemes of terrace roads, railroads, &c., have been proposed upon the bank of the river, between Westminster and the City. I have been applied to by Sir Frederick Trench, Mr. Martin, the celebrated artist, and other ingenious gentlemen respecting them. As regards the embankment of the river, it might be sufficient to say that the recommended line does not interfere to prevent the formation of any of the terrace or road schemes; but, as our attention has been drawn to the road improvements

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[*] That this recommendation may be better understood, a drawing, showing transverse sections of the river, where embankments are formed, and where recesses or docks are left, with the appearance of the dwarf-piling in front of the recesses at low water, as seen from the river, is attached to this Report.

upon the banks of the river above Vauxhall Bridge, where Mr. Thomas Cubitt is displaying that enterprize by which he has individually done more than any man living to enlarge and adorn the south-western part of the metropolis, it would be improper not to refer to this as a result of the projected embankments, which Mr. Cubitt will probably be the first to carry into effect on an enlarged scale upon the estates of the Crown and the Marquis of Westminster; indeed, he is already making preparations for so doing. So far as we have been able to judge, from the opinions of those most largely interested, there appears a probability that a carriage-way will be formed along the bank of the river from Chelsea, nearly to the new Houses of Parliament. The east side of Millbank street is the first interruption. If, upon the site of the worst part of Westminster, the property of the Dean and Chapter, or upon the vacant Crown land round the Penitentiary, a basin or dock were formed, with an entrance near the Horseferry, for the trade of the present Millbank street wharfs, the houses in that street, which are of value chiefly as connected with the wharfs, might be taken down, and the site of them, with the embanked ground of the river, applied to form a terrace attached to the Houses of Parliament; the view of the river from the drive would be uninterrupted from Chelsea until reaching the Houses of Parliament, where the road would necessarily leave the water side for Palace yard, Parliament street, and Whitehall; it might then turn down Whitehall-place or Scotland yard, whence it could be carried on arches, springing from piers in the new embanked ground, down to Blackfriars Bridge, and thence by a direct street to St. Paul's and the Royal Exchange, or might fall into some of the new and improved streets in progress or projected by the city authorities. A splendid communication would thus be formed from Chelsea or from above it, along the river, into the heart of the city. It may be some time before all this can be accomplished; but it would be easy to show that from Chelsea to Millbank, and from Millbank to Blackfriars, it would not be a very difficult or expensive work, that it would not interrupt the trade of the wharfs between Whitehall and Blackfriars, and that the proposed line of embankment would be in furtherance of this object.

It may not be irrelevant here to observe that the principle "that the banks of navigable rivers are public highways" may have been of general or even universal application at one time, but it is to be taken with numerous exceptions in the present state of this country. In many cases an immediate communication between the shipping and the wharfs may be more important, even to the public, than the right of way which intercepts that communication. Generally, however, the right has been so long lost on the Thames, near London, as in the case of the Forty-foot way, without reference to considerations of this kind, by the gradual encroachments of individuals, always alive to their own interests, and by neglect on the part of the public, that particulars of the right have been forgotten, and the encroachment has become so fixed and established as to render its removal difficult. Such rights of way have been to a great extent lost without any equivalent, which might have been obtained had attention been paid and a bargain been made at the time. This matter requires the instant and vigilant attention of the Conservator and his officers wherever buildings and water-side alterations are in progress: without it, the difficulty of preserving the walks which still exist, and of forming the terrace roads to which I have referred, will be much increased, if not rendered insurmountable. Correct plans and descriptions, with periodical surveys, would be most useful.

The Thames is at present the great drain of London and Westminster: towards it the ground, the streets near it, and all the sewers incline; and, although there are imperfections, there never was, nor is there, I believe, o city in the world so perfect in its system of sewers as London. A stranger can have no idea of their number and magnitude; and I believe there is nothing in England that would more surprise a foreigner, could he be made acquainted with the detail, than the drainage of the metropolis.

It is to these sewers, and to the water sent into the houses by a power of about 2000 horses, chiefly by engines belonging to eight water companies, and then passed through the sewers into a river of the magnitude and with the flow and ebb of tide already described, that densely-peopled London owes in a great measure its present health. But it is still desirable that the contents of these sewers should be carried off without entering the Thames above or opposite to London. Can this be done?

On the Surrey side, where the ground is low and nearly level, from Lambeth to Greenwich and Woolwich, a great sewer might be formed, which would intercept and convey the contents of the principal sewers into the river as low as Greenwich, or just above Woolwich; but on the city side there would be greater difficulty. Mr. Martin was, I think, the first to propose a sewer being carried under his projected river terrace, and thence to the Regent's Canal basin at Limehouse. The interference with the coal trade would be the greatest objection to the above plan, so far as the terrace would extend, which could not, I think, be lower than Blackfriars Bridge; and to continue the sewer lower, either under or in front of the wharfs, and in front of or round the St. Katharine's and the London docks, would be a work, to say the least, of immense difficulty and expense. Mr. Thomas Cubitt has suggested to me a great sewer on the north of the city, extending from the extreme west to east, beyond the river Lea, which would be more practicable, and would take off a vast quantity of the filth that is now an annoyance to the city. This subject is, however, too great to be fully discussed in this Report.

Taking, therefore, the Thames as the general recipient, the evil arising from the sewers will be very much reduced by the proposed embankment and contraction of the width, which will quicken the velocity, and get rid of the vast beds of mud which pollute the banks of the river. The water from the sewers might be discharged under the embankment wall, and even confined in cast-iron trunks laid in the bed of the river, and reaching further out into it under the level of low water, as has been done by the Committee for the repair of Blackfriars Bridge, with the Fleet, one of the largest sewers.

The mud on the sides of the river Thames near London, between high and low water, is of a different kind from that of rivers in the country; it appears in a state of constant fermentation, and is covered with animalculæ which are generated in it, and which give the surface a red colour. This arises, I conceive, from the animal and vegetable matter discharged from the sewers, united with the washings down of the broken clay of the banks into the stream, with which it is mixed, and is carried along by the current until it finds a place upon the bank, where the diminished velocity, caused generally by the excessive width, is insufficient to move it further on. These broken banks are therefore an evil, and the evil is much increased by the wash of the steam-boats. One would think that generally the owners of the land would, by means of some wharfing or other defence, prevent the wasting of their land, and the danger to their embankments; but it does not appear that they always do so; and if there be a power of compulsion I think it should be exercised. The extent of land above Chelsea and below Greenwich, which is in the position I have described, is very great. This appears to me to be a principal cause of the muddiness of the Thames at and below London. But for this evil, the action of the steamers upon the bottom, as well as on the sides of the river, is beneficial in stirring up the mud and carrying it down the stream. It may be remarked generally that in but few parts of the river within

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our survey is there mud in the bottom under low water. It is nearly all upon the sides, and its marginal line is well defined generally at the low-water mark of low tides, under which the stream is sufficient to prevent so light a body as mud from remaining. The bottom of the river, under low water generally, excepting in the deep holes made by the ballast-lighters, is gravel or sand, lying over the original formation, the London clay; in some places there is peat and silth above the gravel, which the strength of the stream, where the river is wide, has never removed, and which, from not being taken as ballast, the barges of the Trinity House do not raise, and would not, I believe, be justified in raising at the cost of the corporation. By a grant or charter from Charles II., this corporation was indeed authorized to receive certain fines and contributions to be applied in removing shelves and annoyances in the river; but these fines having long since been otherwise appropriated, and the Trinity House being therefore left without funds available for this purpose, the grant has been, I believe, in this respect a blank letter. Captain Fisher and Mr. May (draughtsmen to the Port and Navigation Committees, who has assisted us throughout) inform me that ten years since the bottom of the river, above bridge, consisted in many places of mud where gravel is now found. I consider this to have been caused by the increase of scour since the removal of old London Bridge, as well as by the action of the paddle-wheels of the steamers already referred to.

Greater care than was required previously to the introduction of steamers is now necessary in preventing bricks, or similar hard materials, being laid within the influence of the wash by the paddle-wheels. This is even worse than laying mud, as such heavy materials are gradually washed down, become indurated with the sand and silth, and form hard shoals in the bottom of the river. It appeared to me that this remark was quite necessary in reference to the Surrey side below Battersea Bridge, where much rubbish had been laid even upon the slope of the river. This should be prevented by some more effectual way than the promise of the workmen, who are generally paid by measurement, and with whom therefore the temptation to throw the load overboard is very great. If a wharfing were made in the proper line, the owners of the ground would be interested in having their wharfing backed; but the wharfing should be done before the material for filling-in is brought to the place.

I should have supposed that the coal-ashes from the steam-boats would, as a material for making a strong mortar, and other purposes to which a dry hard substance is applicable, have been too valuable to be thrown overboard as is at present the case, and is openly done whilst the steamers proceed: judging from the number of them, the quantity of ashes must be very great. This ought to be prevented.

Were the embankments to be general, the material which forms the shoals might be taken up and advantageously placed so as to raise the ground behind the walls.

Of all the various matter which the Thames receives on a large scale, none appears so deleterious as the lime-water, containg a portion of ammonia, from the gas works; and, in consequence of the proximity of some of the establishments to the river, the prevention of this seems a matter of great difficulty. Chemistry may find a way of converting this to a profitable use, as has been done to a great extent with the ammoniacal liquor, and then the evil is sure to end. At present, evaporating the aqueous portions of the lime-dregs under the furnaces appears the only permitted way to get rid of it, and to prevent the illegal course of turning it into a drain, and thence into the Thames, which has required the constant vigilance of the officers of the Conservator. It is be hoped that the use of gas, now almost indispensable, is not inconsistent with the avoiding so great a nuisance in the river, and that if the directors of gas companies were sensible of the evil they cause, they would take effectual means to prevent their officers from being guilty of the offence. Wherever the drains from the gas works empty directly into the river, the matter is visible on the water; and thus the discovery is more easy than when it is discharged into covered common sewers. In each case all the communications from the gas works should enter the river above low water; they should be well understood by the river authorities and be carefully watched, and the law should be strictly enforced. To relax is clemency to the few and injury to the many. I am assured from good authority, that there is no sewer from the chartered gas company's large manufactory in Westminster; that all their liquids are evaporated under the furnaces; and that every gas company might do the like were they so disposed.

Independently of the above, the removal of the shoals which obstruct the navigation both below and above London Bridge, is deserving of particular notice. They are shown upon the plan with the depth in feet at the low water of spring tides. The following are the worst below bridge:—

1. Ascending the river, the first bad shoal is below Erith, called Rand's Hill, a patch in the middle of the river, about 300 yards long by 100 yards wide, which has upon it (at the low water of 17 feet 10 inches under Trinity standard) a depth of 8 feet.*

2. A little higher, Cold Harbour, a point of sand extending from the north shore to near the middle of the river, also 8 feet.

3. A shoal of sand in the same reach (Erith), 200 yards above the last, and having a depth of 6 feet.

4. Dagenham Shelf extends from the north shore, nearly half way across the river, with 8 feet.

5. Barking Shoal, one mile below Barking Creek, nearly in the middle of the river, has also 8 feet.

6. Barking Shelf commences opposite the Creek, continuing nearly half a mile down, and extends across nearly two-thirds of the river, with from 6 to 10 feet only, in the line of navigation. This is considered the worst shoal in the river. The Trinity lighters have for many years worked at the place, and have taken up an immense quantity of gravel; but the greater part of the clay and peaty surface, which is the worst part of it, remains.

7. A shoal opposite Gallion's Point extends from the north side about one-third across the river, with 7 feet.

8. Ham Shelf, opposite Woolwich dockyard, extends from the north shore upwards of half way across the river, for a length of a quarter of mile, exclusive of patches and projections higher up, and has upon a great part of it only 6 feet.

9. Bugsby's Hole is altogether a shoal water reach, in places only 8 to 9 feet; with some shelves and small shoals having only 6 to 7 feet.

10. Immediately opposite the river Lea, a shoal extends from the north side to the middle of the river, with only 8 feet.

11. A little above the entrance of the Lea, is a dangerous small rock of concreted gravel in the middle of the river, with only 9 feet.

12. Two "middle grounds" in the centre of the river, between Blackwall and Greenwich, have upon them 9 to 10 feet.

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* Very low tides ebb 3 feet lower, leaving of course 3 feet less water upon all the shoals than is stated above.

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13. Whiting Shoal, a little above the Commercial dock entrance, a dangerous shoal, in nearly the middle of the river, has in places only 7 feet.

14. Limekiln-shore dock, from the north side, goes nearly two-thirds across the river, with only a depth of 5 feet.*

From the last-named shoal up to London Bridge there are no other bad shoals.

I find by calculation, that about 60,000*l.* would remove all these shoals from the line of navigation, and make a passage 12 feet deep at low water, were none of the materials suitable for ballast. The sum does not apppear large, compared with the almost national object. The Birmingham Canal Company, for whom I am professionally concerned, are laying out nearly four times the amount in a new canal, eight miles in length, fitted for the trade of narrow canal boats only, and intended, not for a new trade, or a new source of revenue, but to shorten the route for the present trade, chiefly of coals and iron, from the mines to Birmingham. A very small rate, say one-eighth of a penny per ton, upon the trade, would effect it. The amount of tonnage which paid light dues on passing the Nore inwards, in 1840, was 4,406,000 tons. My estimate for the still further improvement of the Clyde, for which an Act was passed in 1840, was 800,000*l.* Ought then the immense trade of the Thames to remain any longer impeded, and the vessels navigating it to continue any longer liable to delay and damage, if the cause of such impediment, delay, and damage can be removed for anything like the sum I have named?

Above London Bridge the character of the river is entirely different, owing, as has been before stated, to the piers of the old bridge, which existed for about seven centuries. Since their removal, some of the Trinity-House lighters have been employed, at the request of the Lord Mayor and Port of London Committee, though above their legitimate range of action, and have taken upwards of 150,000 tons in the short space between London and Southwark bridges, which has cleared away the shoals there; but above Southwark Bridge they are so general, and so irregular in their position and depth, that it is difficult to describe them, except by reference to the plans and sections. The evil is increased by the gravel which is laid over the mooring stones, and raised improperly and unnecessarily above the general surface of the river's bed. It will be seen that many places in the middle of the river are above the level of low water, preventing all navigation for barges between half ebb and half flood, and making the passage for steam-boats tortuous and difficult between three-quarter's ebb and the first quarter of flood, and such that when there is little land water in the river the smallest steam-boat cannot move at low water. The evidence already referred to, which was given on this subject in the session of 1840 by the masters of steam-boats, confirms this statement, if indeed that which may be so frequently witnessed by every passenger can require confirmation.

There are at present several wrecked vessels sunk in the navigable channel of the river. I do not pretend to know the law in such matters; but surely it is the duty of the owners of the vessels to raise, without delay, and remove such dangerous interruptions out of the highway of the river, especially as delay increases the difficulty of raising, and lessens the value of the wreck.

I have appended to this Report a Table, showing at various points the present and proposed width of the river, with the contraction on each side. It is not necessary for the public objects I have stated that every part should be embanked. To some it may be inconvenient in various ways; but if the unembanked part, or the dock, become private property, to be used only by the owner of the premises behind it, its value to him may thus be increased, and he might have the option of wharfing in the line of the adjoining quays, whenever he might wish to do so.

The effect of every erection between high and low water is to decrease the quantity of tidal or back water, upon which the depth below these embankments mainly depends; and the embankments we are recommending for narrowing the river are of this character; but as the material for filling behind the embankments is to be taken from the bottom of the river, the effect of this will be to let the water ebb out lower, and thus to increase the space for the return of the flood and the backwater. I find, by calculation, that the lowering of the surface of the water above bridge one foot vertically for four miles in length will equal in cubic quantity the whole solid of the embankments above London Bridge.

In the times of heavy rains, the low lands up the river are liable to be flooded. Mr. Telford states, that the height of the water at Teddington, during the land flood of December, 1821, was 7 feet above the high water of Trinity standard. The effect of the narrowing by embankments will be to increase, to a small extent, the obstruction to the descending floods at the first of the ebb; but this will be much more than compensated for by the additional depth which operates through the whole period of the ebb; so that the general measure will, as respects the drainage of the country, be a decided advantage.

Whatever wharfing is done in the proposed line should be done securely; and in case of failure a ready means of rebuilding, or at least of preventing a nuisance, is essential, whether it be a clay bank or a wharf wall. The public ought to be protected against damage by the owners of property abutting upon the river; and, if the owner neglect to do this, there is, I apprehend, or surely ought to be, a power to compel him, as well as a summary way of abating the evil. This should extend to all unlawful or unauthorized erections within the line of high water.

I am afraid that in some points referred to in this Report I may have gone too much into detail—may have been in others too general—and may have entirely omitted matters of greater moment than those I have remarked on; but surely enough has been thought of and said to show the great, the almost national importance, of the subject, and the capability of adding essentially, at comparatively little expense or trouble, to the commercial and general utility, and to the ornament of this noble river, for the navigation of which so little has been done during many centuries, and to the making of it still more instrumental to the comfort and health of the inhabitants, as well as contributing to the extent, beauty, and value of the property upon its banks.

I am, &c.,
JAMES WALKER.

To the Chairman of the Navigation and Port of London Committee.

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Captain BULLOCK, R.N. *on the proposed Embankment of the Thames.*

INQUIRIES having been instituted by the Corporation of the City of London respecting the practicability and expediency of an uniform embankment of the Thames throughout its course, it has been re-

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* The depths below bridge are taken from the excellent survey of Captain Bullock, R. N., under the direction of the Admiralty. Those above bridge are by Mr. Comrie and Mr. May, under my direction.

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ferred to me to consider and report on the effects likely to be produced by such a measure on the bed of the river.

Previous to my answering the questions submitted to me, it seems desirable that I should state what I conceive to be the natural laws regulating the movements of a river, and the formation of its bed, so far as such laws are involved in the subject under consideration.

A current of water obeys the general law of motion, and continues its course in a straight line until it meets with some obstacle which forces it to turn aside; hence, at every bend in the channel of a river, the current runs in on the concave side, and presses on the bank.

The velocity of a stream, under like circumstances of declivity and pressure, depends on its freedom, or, in other words, on its breadth and depth. In any given section of a river the greatest rapidity of a stream will, generally speaking, be found in the deepest part. Where there is a shoal on the side of an active current, the contact of the rapid stream with the retarded and sluggish water on the shoal will have the effect of producing a circular motion, or eddy, in the latter, the extent of which will be regulated by the extent of the shallows. What is here said of shallow water is true of any sluggish water, however deep, which, protected by the irregularities of the banks, adjoins an active current.

Every back-water is attended with one or more eddies, in the centre of which are deposited the particles of sand and mud which were supported and carried along by the water while it had a rapid progressive motion; a bank or shoal is thus formed.

Every bank or shoal in the bed of a river is itself a determining cause of a back-water, and consequently tends to create another bank lower down the stream. The increase of shoals in any one place must there modify the direction of the current, the effect of which modification will be felt lower down; so that the disturbance created by any local interruption in the water-way is sure to be propagated down the stream, imperceptibly, perhaps, in the first instance; but it can hardly be doubted, that, in the course of years, very great deformities in the bed of a river may arise from very slight and apparently unimportant first causes.

It needs hardly to be observed that what has here been said of banks and shoals naturally formed applies still more forcibly to all constructions, such as piers, jetties, wharfs, &c., which encroach on the water-way; and the worst effects of which are often not imputed to them because produced at a distance. A change in these constructions, or the increase of them, may give, more or less, a new direction to the stream; may impel it to plough up new channels, to disturb, divide, and probably, in some measure, to clog the navigable water-way.

In tidal rivers, where there is a current alternately up and down, it may happen that the ascending and descending currents do not take exactly the same channels; their agencies are, consequently, at variance, thereby increasing the disturbance in the bed of the river, the wear and tear of the banks, with other evils.

These principles being established, we may now proceed to consider the question whether it be possible to devise a channel for a river, so constituted as to secure the two conditions of clearness from all obstruction, and permanence; or, in other words, whether, by embankments judiciously constructed with respect to width and form, a river may not be directed in such a manner that its currents both ways will harmonize with the general windings of the course, and whether it may not be freed from all tendency to form shoals and to shift its channels.

It appears to me that these desirable ends may be easily attained by embankment. A river's bed is spoiled by the too great diffusion of the stream, by the wear and tear of the banks, and by obstructions of one kind or another created in the water-way, from all which ensue diversions of the current and a tendency in the river to change its course, throwing up banks and shoals which, more or less, impede the navigation.

Now these causes of deterioration may be completely removed by embankments, reducing the bed of a river to a sufficient water-way, and nothing more, and presenting to the pressure of the stream, at the bends of the river, a solid unchangeable front, of such a form as will guide the current both ways in one channel: if to these embankments be superadded some regulations calculated to preserve inviolate the principles on which the embankments are formed, and to prevent all projections and obstructions in the water-way, it cannot be doubted that the river will gradually work itself a free, uniform, and unimpeded channel; and, having thus improved its course, that it will have no tendency to change it. The same natural agencies which, left to themselves, continually change their direction and plough up different channels in a stream, will, if fixed in their direction and rid of variable and undue hindrances, be converted into the improvers and preservers of the same stream.

It is easy to apply to the Thames what has been already said of rivers in general; but it must not be overlooked than an additional argument for the proposed embankment may be found in the circumstance that the Thames is rather wider above bridge than in the Pool; for the contraction of the stream above bridge will probably have the effect of equalizing the current and giving it an equable movement. And, moreover, the single fact that the Pool is in general narrower than the river above bridge is of itself sufficient to show that the latter is wider than necessary.

It would be advisable, perhaps, to expedite by dredging the process of clearing and deepening the bed of the embanked river, instead of leaving it to the comparatively slow operation of natural agencies; but in that case it would be necessary to adopt a better system of dredging than that pursued at present; and, instead of making deep holes in the channels, the dredging machine ought to be employed solely in removing shoals. And, in general, it may be remarked that the mischiefs arising from the neglect of the river's bed or banks, or from injurious interference with them, cost much more for their repair or correction than would suffice to maintain a vigilant superintendence competent to prevent them.

The Thames, though for ages the greatest commercial river in the world, has hitherto been excluded from its due share in the improvement going on around it. In our own times the navigator has received incalculable benefits from science; and, as might be expected from the maritime genius of this country, the chief glory of these scientific labours belongs to ourselves. Nearly all the shores of the known world have been surveyed by British officers; the coasts of our own isles, and the seas around them, have been examined with a patience and an accuracy that will leave nothing to desire for ages to come; nor has the present hydrographer of the Admiralty overlooked the Thames, and, in consequence, it has been lately surveyed with the utmost care and minuteness by the direction of the lords of the Admiralty, but without reference to the embanking of its sides. Amidst all this activity, originating in the spirit of the age, and called for by its wants, it is not surprising that the Corporation of the City of London, actuated by the same spirit, should have directed their attention to the improvement of its banks on a scale commensurate with the advancement of science, and suitable to the vast resources of the most wealthy, civilized, and enterprising city in the world.

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The extension of some care to this object is also imperatively called for by the recent change in the mode of plying on the river, arising from the great increase of small steamers. Many thousands of persons are now occasionally carried up and down the river between bridges in the course of a single day. The navigable water-way has thus acquired a new value; and, while it has grown more desirable to increase as far as possible the available channel, it has also become more necessary to prevent the endless multiplication of piers and jetties which now disfigure and threaten ultimately to affect injuriously the navigation of the river.

In conclusion, I strongly recommend the projected embankment, as a certain means of effecting a great and permanent improvement in the Thames; it would, if fully carried out and maintained with suitable regulations, have the effect of equalizing the current and bed of the river, removing shoals, and increasing the navigable water-way. Owing to the numerous obstructions in the river, with the interrupted and oblique currents attendant on them, as well as the constant wave from the steam-boats which washes the banks, there is a larger quantity of mud kept in a state of perpetual oscillation than formerly, but this will be remedied by unity of channel; and, with an unembarrassed water-way, the stream thus loaded with sedimentary matter will pass onward towards the sea into deep water. The great extent of the mud banks, which now exhale offensive effluvia at low water, would also thereby be much diminished; the stream, being made deeper and stronger by its embankment, would more effectually perform its cleansing office; and these benefits, independent of that of considerably increased facility of navigation, now grown so important, seem to me sufficient of themselves to incite to far more arduous and expensive undertakings than that of merely embanking the river near the metropolis.

To the Corporation of the City of London belongs the honourable privilege of carrying into execution the improvements here discussed,—improvements which, whether considered in respect to utility or ornament, are well worthy of the energies of a great commercial nation.

FRED. BULLOCK, *Captain R.N.*

DESULTORY NOTES.

IT is universally admitted that the navigation of the Thames has long been subjected to inconvenience from the crowded state of the shipping which at times throng the river, and that it is still frequently and seriously interrupted from a variety of causes, in defiance of law and the regulations which it has hitherto been found expedient to prescribe, as well as of the earnest endeavours and vigilance of the harbour-masters.

The interest which the Corporation of the City of London has in the prosperity of the trade of the metropolis renders it imperative that, in order to secure to the public a clear and unembarrassed water-way, and thus establish a free intercourse with the fountain of commerce, every cause of impediment, however remote, extraneous, or artificial, should be investigated, and, as soon as possible, removed.

Some of these obstructions proceed from original shoals, which have doubtless operated in giving the bed of the river its present form, and are growing causes of impediments to the navigation of a river. This subject well deserves the consideration of the Corporation; for, whatever may be the difference in opinion as to the ways or means to be employed in removing shoals which obstruct the navigation of the Thames, it is certain that some such means ought immediately to be devised, that the transit of ships be no longer delayed for want of water to carry them to their final destination—the docks.

An instance of the facility of deepening and preserving an uniform depth, as well as the advantages resulting from the operation, may be seen at the entrance to the St. Katharine's dock, where there is now at low water, off the principal buoy, 20 feet, shallowing gradually to 8 feet at the wharf; but as similar advantages are contemplated in the general embankment of the Thames before referred to, it is needless to dilate upon the subject.

The lower Pool is occasionally in a confused state, and is at those times extremely dangerous, when the water-way is contracted by the tiers of colliers, even when the lawful space of 300 feet is preserved; but I contend that it is not sufficient to yield to the public the mere possibility of navigating a crowded river; the certainty, as far as human means will allow, ought also to be secured to them. Circumstances frequently arise to prove that the 300 feet is not sufficient for the purpose of a safe navigation, as well as to show that a little timely assistance at that narrowed part of the river, would prevent many serious accidents; positive means, and the facility of using them, ought therefore to be provided and at hand, the expense of such aid being defrayed by the vessel requiring it; for whatever produces danger, difficulty, or delay in the transit of the Thames cannot but be regarded as a grievance in a country where so much depends upon a good maritime approach to its metropolis.

The practice of colliers anchoring in the stream, at the entrance to and in the Pool, while preparing to take their respective stations, and hauling out into the fairway before the proper time to sail, is a just cause of complaint and productive of serious obstructions to navigation, as well as being a fertile source of accidents and injury. On no account whatever, therefore, should this malpractice be permitted to endanger the public safety.

The harbour-masters should be armed with authority to remove forthwith the obstructing vessel or craft, charging the offender with the costs, who should also be liable to a penalty. Each vessel ought to be provided with a boat well manned, a good kedge, and warps, in readiness to run out the latter to the nearest vessel in the tier, and thus obviate the necessity of letting go the anchor and encroaching upon the already too limited space assigned for navigation. An alteration in the bye-laws of the Port of London to this effect would confer a lasting benefit on the public.

The in-shore navigation (or transit for small craft) on each side of the river is also improperly obstructed by coal barges, which crowd the inner passages on the one side, and the loaded coal and timber, barges, mischievously and unnecessarily detained, on the other, converting a serviceable portion of the river into floating warehouses; and is, in consequence, so great a source of hindrance as to call loudly for strong remedial regulations.

It cannot be denied, however, that the increasing state of the coal trade in the Port of London loudly calls for dock accommodation, as during the first six months of this year, the arrivals have exceeded the last or preceding period by nearly 600 ships and 167.000 tons of coals; and, as the consumption of the article from the progressively increasing population, and the erection of manufacturing establishments, steam navigation, &c., is daily augmenting, the day is not far distant when some direction of the Corporation will be found necessary to oblige colliers to discharge in wet docks, and thus clear the river of an obstruction which now of necessity is tolerated, but which is, nevertheless, highly prejudicial to the trade of London.

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The recent excellent plan of placing colliers in sections, is a positive benefit to the community, and calculated to effect a permanent improvement of the navigation of the river Thames.

The quantity of rubbish daily and hourly thrown into the Thames calls for serious consideration, and for the most energetic measures on the part of the corporation to put an immediate stop to such irregularities, the tendency of which is to ruin the river. An Act of Parliament (54 Geo. III. c. 159), has amply provided for these grave offences. And if due notice was given to every steam-boat that the laws on this head would be rigorously put in force, the fear of punishment (or information) might, in some measure, deter them from the open practice of such delinquencies.

The same Act of Parliament refers to the landing of rubbish upon the banks of the river, which ought to be placed above high-water mark (spring tides), and out of the influence of storms or land floods, &c., on pain of fine or imprisonment.

This being the case, nothing more is necessary than the strictest supervision in order to detect the offender, as there are proofs on record that this shameless practice has been carried on from time to time, until it has become seriously detrimental to the river.

Next to those who wilfully and wickedly throw rubbish into the river, stand those who negligently allow their wharfs, banks, or forelands to fall into it; and although the offence itself may not be of so serious a nature, the effect is the same; and as it is the duty of the authorities to punish delinquency on the one hand, so it will be in the execution of their office, as conservators of the Thames, to protect it from the effects of negligence on the other; and as it can be easily proved that the results are the same, it becomes the imperative duty of the proprietors of such lands to enclose safely that portion which is liable to be washed by the high tides, or exposed to the wave caused by steam-boats.

FRED. BULLOCK, *Captain R.N.*

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Saunders, on the proposed Embankment of the Thames.

No. 278.

The WATER-BAILIFF's *Report on the proposed Embankment of the Thames.*

GENTLEMEN,

London, 13*th Dec.*, 1841.

In compliance with your directions, I accompanied Mr. Walker and Captain Bullock upon a survey of the river Thames; and the great benefits which must be secured to the public from its general improvement, under an uniform system, appear obvious.

The plans now submitted for your approbation show the existing and proposed lines of embankment between Putney and Gravesend, as well as numerous shoals which obstruct the navigation.

The proposed lines of embankment have been laid down after due consideration; and, although it is not probable that they will be carried into full effect for many years, their value in assisting the immediate and future operations of the Committee and ensuring the confidence of the public, will, I trust, more than compensate the corporation for the outlay which they have occasioned.

For centuries past, the river, within the limits named, has received little improvement, whilst it has been the source of wealth to the metropolis, and borne thereto the funds with which many of its most splendid improvements have been accomplished. Rejoicing, as I do, to witness those improvements, it does appear to me to be surprising that no part of the coal duties should be regularly devoted to the equally important object of improving the river.

Having once sanctioned a systematic course of proceeding, you will, I apprehend, without any extension of the powers heretofore exercised time out of mind by the corporation, be enabled to afford thereby great facility and encouragement to the landed proprietors, in adopting such lines of embankment as may be approved by you. It is not to be anticipated that all would immediately avail themselves of your offers, but as the occupancy from time to time changes, so we fairly may expect that eventually all would be accomplished without any compulsory measures being resorted to, which would inevitably raise a host of owners and occupiers as claimants for compensation. The frequent applications for leave to embank, even at present made to your Committee, sufficiently prove that a judicious system of encouragement to such applicants, with a certain and definite mode of proceeding, will rapidly increase their numbers.

The large embankments contemplated would, by reducing the width of the river, and consequently diminishing its capacity for the reception of the tidal waters, prove injurious to the navigation unless accompanied by a corresponding increase in the depth of its channel; stringent resolutions will, therefore, be necessary to compel parties embanking to take the gravel and ballast required for their embankments from the bed of the river under proper regulations. It should also be distinctly understood that no permanent projection of any kind would hereafter be permitted from the new lines of embankment; and the proprietors should be bound to construct and maintain the frontage of sufficient height and proper materials.

Individuals would be greatly encouraged to undertake the outlay which must be caused in constructing extensive embankments, by the charge being only made for frontage instead of the superficial extent of the land reclaimed; and one shilling per foot would not, I consider, form any impediment to their applications for your licence to embank. Such moderate terms, and the appropriation of the present and future navigation rental to the carrying out the great work you have undertaken, would demonstrate that the improvement of the river is the sole aim which the corporation have in view; and those portions of the embankment which may be devoted to public purposes might be sanctioned without any rent being levied thereon.

In a report dated the 17th of November, 1834, I had the honour to suggest to the Lord Mayor and corporation the importance of their providing piers for the accommodation of the public using steam-vessels, under a conviction that this was the best plan for preventing improper and dangerous encroachments by individuals for that purpose, and that a large revenue might be derived therefrom applicable to the general improvement of the river, by the removal of shoals and otherwise.

The numerous piers since formed have fully borne out, and indeed surpassed my anticipations, both as to the extent of traffic and the want of control over them; but I fear the same cause—their numbers, will now prevent the corporation from adopting, with pecuniary advantage, a competition with those individuals who have already established piers, although the public would undoubtedly be benefited by such interference of the corporation.

The general use of steam-vessels as a means of transit for passengers has rendered convenient landing-places for their use indispensable; but it may be hoped that, when the new lines of embankment are carried into effect, no piers above Blackwall will be required, as sufficient depth of water

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may be provided then, close alongside of the wharfs, for the accommodation of the steamers. The frightful overloading of these boats, occasionally, demands the interference of the Legislature.

I proceed to notice some other points which arise incidentally from the subject, but which are closely connected with the preservation and improvement of the navigation.

Regulations are required for the working of ballast-engines, both above and below bridge, so that they may be confined to those parts of the river where not only good ballast may be obtained, but where also its removal will be most advantageous to the navigation. The Trinity-house will no doubt assist in such useful regulations.

The active proceedings lately taken against parties for throwing mud and dirt into the river has checked the practice; and the recent sentence of two months' imprisonment on one of the offenders, will, I trust, further operate as a salutary warning.

Any shoals which are caused in the river by the soil and rubbish brought down by the sewers ought, in justice, to be removed by the Commissioners of Sewers.

The removal of wrecks having been proved by the corporation, in the case of the brig "William," practicable under very difficult circumstances, and at any depth of water in the river, it is to be hoped that the large sum of money expended upon that occasion will preclude the necessity of any further similar expenditure on their part, by depriving the owners of the only plea which could justify the continuance of the nuisance, namely, the impracticability of its removal.

Although their situations are denoted by piles, the moorings in use at Blackwall which extend across the river, are a great nuisance to such ships as are compelled to let go their anchors there; but even that safeguard is not adopted at Deptford, where similar moorings are lying, which renders them still more inconvenient.

Of casual nuisances, but of daily occurrence, one of great danger is the dropping of anchors within or near to low-water mark.

The use of vessels, which are permanently moored in the river, as stores and workshops, is upon the increase; and some means should be adopted to prevent their owners hereafter claiming as a right what is now only upon sufferance, and which, if permitted to extend unchecked, must become a very serious cause of complaint, not merely from obstructing the navigation, but because there is no fair competition between parties paying rates and taxes and those who pay none.

The distance allowed to wharfs for the necessary accommodation of their trade, as suggested by the city conservancy jury, should be denoted by piles.

The lines proposed for the new embankment, it must be observed, are only the best as appearing the most practicable; but if, under more favourable circumstances, funds could be provided either from the landing-places, the rental, the coal dues, or other sources, they might be very advantageously expended in removing some of the present encroachments upon the river. I allude particularly to the embankments near Globe-stairs and Old Swan-stairs, where a greater width is required to produce the proper scour, as well as for the general improvement of the navigation.

Your Committee is now in possession of plans of the river from Yantlet Creek to Putney, and it is most desirable to continue them up to Staines: I would suggest that an uniform scale should be adopted for the whole, and a complete set of plans laid down thereto; and, further, that a periodical renewal thereof should be provided for, so that all future alterations of the river and its banks may be distinctly shown and easily traced.

I have the honour to be, &c.,
NATH. SAUNDERS, *Water-bailiff.*

To the Worshipful Navigation and Port Committee.

No. 279.

Mr. LEACH's *Report on the proposed Embankment of the Thames.*

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GENTLEMEN,
Guildhall, 18*th December*, 1841.

The conservancy of the river Thames, as vested in the Mayor and Corporation of the city of London, the consideration of which subject has been the immediate occasion of this Report, extends from Staines at the extreme boundary of the county of Middlesex, on the bank of the river, as denoted by the so-called City Stone placed thereon, bearing date A.D. 1280, at a distance of 37½ miles westward of London Bridge; and continues down the river eastward to Leigh, in Essex, on the north shore, a distance of about 42 miles, and on the south shore through Yantlet Creek and up the river Medway, a distance of about 54 miles below London Bridge, at both which places similar stones are erected.

The navigation of the river westward of London Bridge having been many years seriously obstructed, and in dry seasons nearly impassable for loaded barges, without constant recourse to the injurious practice of drawing flashes of water from the upper districts of the river, which occasioned both delay and expense, from the want of those improvements which have since been effected, Acts of Parliament were obtained by the Corporation in the years 1774 and 1777 (14th and 17th Geo. III.), by the former of which powers were obtained and carried into execution, at the expense of the Corporation, under the direction of Mr. Robert Whitworth, civil engineer, for making a horse towing path, with the necessary bridges and works, from Putney to Richmond, a distance of nine miles, where previously the towing of barges had been performed by large gangs of men, who were loitering about from tide to tide for that employment:—for repairing and improving the towing paths in other places or parts of the district, by building bridges, &c.; digging new and more convenient barge channels; stopping breaches; improving the river by contractions where necessary, and other important works.

The second Act of Parliament above mentioned, namely that of 1777, was passed for completing those improvements, and for enabling the Corporation to purchase several private tolls imposed where the original towing-paths had been washed away for want of repairs or preservation, and new paths had been set out by the proprietors of the adjacent lands. The Act also authorized the Corporation to collect a small toll in lieu thereof, for the purpose of making further improvements in the navigation of the river, keeping the works in repair, &c.

Although great ameliorations were effected under these Acts of Parliament, the navigation continued in a very imperfect and unsatisfactory state, being still passable only by means of flashes in low water seasons, and was attended with great delay, uncertainty, and expense, both in times of high and low water, to the parties who made use of the extensive districts of the Thames navigation. Repeated attempts were made to obtain Acts of Parliament, to avoid the navigation of the river altogether,

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on account, as was alleged, of its imperfect state, by the formation of separate canals. These attempts were resisted successfully by the Corporation, with difficulty and at great expense, until, in the years 1810, 1812, and 1814, powers were obtained under three Acts of Parliament by the Corporation of London, for more effectual improvements of the navigation within its jurisdiction westward of London Bridge. and new tolls granted to defray the expenses thereby incurred.

These powers were immediately carried into execution, under my direction, by the erection of six pound locks, at the following places: namely, at Teddington, Moulsey, Sunbury, Shepperton, Chertsey, and Penton Hook, with moveable or opening weirs at the five first-mentioned locks, by which about 21 out of the 32 feet of the natural fall of the river between Teddington and Penton Hook, a distance of about 15 miles, is penned up; facilitating the navigation of barges laden to the depth of 3 feet 10 inches, as restricted by Act of Parliament, during the low water seasons. This penn, removed or taken off in times of flood or high water, has the effect, when shut in, of slightly retarding the downward passage of vessels by checking the velocity of the stream; but thereby, as well as by increasing the depth of water over the shallows, materially facilitating the progress of the vessel on her upward passage.

During the execution of these works, and subsequently, the towing-paths were generally raised to provide for and secure the safe passage of horses and craft in high water seasons; new and more convenient barge channels were excavated, a new towing-path, about a quarter of mile in length, was made through deep water at Staines, where the towing had previously been effected by means of a long and heavy line hired for the purpose, occasioning much inconvenient delay and expense. Several other extensive improvements have been made, whereby certainty and dispatch for the navigation have been obtained, the duration and ill effects of floods diminished, and the extensive drainage connected with the river Thames assisted: this last being an effect which may generally be expected to follow the improvement of river navigations.

On account of the severe wear and tear of the works above noticed, in such a river as the Thames, large and expensive repairs are constantly necessary to keep them in an efficient state; and it would seem that the duties of the conservancy (except, of course, as regards the fishery) cannot better be discharged than by so doing; and in this part of the river, namely, between Staines and Putney, a distance of nearly 30 miles, where the towing path occupies one bank of the river, and the other bank is required to be continually watched and kept in the state most favourable for the navigation, little more remains to be done or recommended than a diligent perseverance in the same system of improvement and preservation, as the means best calculated to promote the public benefit in connexion with the river navigation, its extensive and important drainage, and the other valuable interests dependent thereupon.

Below Putney and Fulham Bridge the river, although so capable of improvement for the purposes of navigation, has, for want of funds, been allowed to remain nearly in its natural state, with irregular banks, inconvenient channels, and formidable shoals. The first obstructions to be noticed are the two wooden bridges uniting Putney and Fulham, and Battersea and Chelsea. Each of these bridges is inconveniently constructed and situated with regard to the navigable stream, occasioning a cross set of tide through the navigable openings, which are themselves also of insufficient width for the safe passage of all, but particularly of steam-vessels, whether employed as passage-boats or for towing loaded barges. To remedy these inconveniences would be neither difficult nor expensive, and should be done without further delay, more especially when so great an improvement as the removal of the present shoals is accomplished, as it has been proposed, above and below these bridges.

To compensate for the want of an useful application of steam power for towing vessels, as well as on other accounts, the continuation of the towing-path from Putney to Chelsea would be a manifest improvement to the navigation of this part of the river. Great delays and expense are not unfrequently occasioned for want of such an accommodation, particularly during land floods and adverse winds; while the improvement of the channel consequent upon regular contractions of the width of the river, the removal of shoals, and the uniformity of the banks, would all be assisted by the execution of the proposed towing-path, in a part of the river where sufficient interest does not at present exist, to induce the landowners on the banks to carry into execution, or even contribute towards, such an improvement. The length of the river between Fulham and Battersea bridges is about two and three-quarter miles, and its improved average width 713 feet. Those portions of the banks not occupied by the proposed towing-path, including part of the shores of Fulham, Wandsworth, Battersea, and Chelsea, would in all probability be gradually improved by the owners and occupiers, agreeably to the plan which accompanies this Report, and which has been carefully surveyed by James Walker, Esq., President of the Institution of Civil Engineers, Captain Bullock of the Royal Navy, the Water-bailiff, the Principal Harbour-master, and myself. By this plan an ample waterway is provided for the navigation, and by the excavations from the shoals necessarily made to fill up the embankment, a sufficient receptacle would be reserved for such quantities of tidal water as are indispensable for scouring-effect throughout the pools, and for preserving, by a slightly increased velocity and properly regulated course, the improved navigable depth.

Between Battersea and Vauxhall bridges, a distance of about two and a half miles, the river as it increases in magnitude does so in importance, on account of the multiplied population and the value of the property on its banks. The contractions described on the plan would doubtless be beneficial, both to the navigation and the landowners, by many of whom, there is little doubt, the improvement would be gradually executed. The present width of the river varies from 1,010 feet to 640 feet, and it is proposed to be embanked to an average width of 720 feet, which would be effected with the same results and advantages as before described, and would probably likewise afford facility, on one shore or the other, for a carriage or foot-road, conducing both to the benefit and enjoyment of the public.

From Vauxhall Bridge to London Bridge the necessity for the improvement of the river by means of contraction and embankment increases in proportion to its magnitude and importance. In this length of about two and a half miles, the width at present varies from about 910 feet just below Vauxhall Bridge, and nearly 700 feet water-way at London Bridge, to a width, above Westminster Bridge for instance (before the embankment for the Parliament Houses), of 1085 feet; at Hungerford market of 1490 feet, at Waterloo Bridge of 1245 feet, and above Blackfriars Bridge of 1000 feet. The consequence of such prodigious irregularities, as may be naturally expected, is the existence of shoals in the river, and large accumulations of mud on the shores; the latter receiving constant additions from the filth poured into the river from the common sewers throughout the extensive drainage of such an enormously populous district. This accumulation of mud cannot but be most injurious to health and unfavourable to navigation, particularly to that part of the latter which is effected by steam power, and which passes up and down at all times of the tide. These evils, although existing before, were not so apparent as they have

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been since the removal of the old and the building of the new London Bridge: indeed, a state of things more requiring alteration and improvement than the present can hardly be imagined.

The most effectual remedy for these inconveniences, and one which would simplify and render more efficacious the duties of the conservancy, the proper discharge of which is now attended with difficulty and uncertainty, would be the execution of the improvements described on the plan prepared by Mr. Walker, and lately re-surveyed and corrected, which was submitted to a Committee of the House of Commons in the Session of 1840.

When the Committee which sat relative to the rebuilding of the Houses of Parliament, of which Lord Granville Somerset was chairman, required to have the utmost possible quantity of ground that could be spared from the river, to be appropriated to the enlargement of the site for the said buildings, and which has been since so occupied, the line of embankment in that part of the river was at once determined, ranging upwards with the former embankment at the Penitentiary, and proceeding downwards in a line nearly parallel with the low-water mark. This embankment may be executed as may be most convenient to the wharf occupiers, either by low wharfing to admit of loaded barges being floated over it at the proper time of tide, and so to load or unload at the present wharfs, draw-docks, &c.; or, by higher embankment, sufficiently above high-water mark to land and load from and into vessels lying outside the line, and moored to the wharfs within certain and well-defined limitations.

In consequence of the removal of the long-existing dam of the old London Bridge, such an alteration has been and will probably continue to be made in the bed of the river as already to have rendered new foundations necessary to Westminster and Blackfriars bridges, and has, in a more or less degree, affected the foundations of nearly all the buildings (the heavy pile of Somerset House, for instance) and wharfs, on the banks, between London and Westminster bridges. The new embankment would therefore afford an opportunity to give, to all buildings requiring them, secure foundations.

From the beneficial effects to property on the banks of this part of the river, connected as it would be with the removal of shoals and of offensive mud banks, it is reasonable to suppose that the strong prejudices existing in favour of the present modes of transacting the business on the river, arising from long usage and custom, would give way to a better; affording such facilities for the dispatch of business at the wharfs, and ample space for the deposit of coals, timber, deals, and other goods requiring room on shore, as to render no longer necessary the present numerous and expensive floating warehouses, which are a positive nuisance to the navigation. The excavations of the bed of the river, for the purpose of filling up the embankments, whether low or high, would make the requisite ameliorations in the navigable channel. The ends of the sewers may be carried through the embankments, and deliver their contents as nearly as possible at low-water mark, and thus remove the great nuisance arising from the present mode of discharge. It is hoped that all these advantages, with deep navigable channels, and clean and well regulated shores, are so manifest as to render the execution of the work, either by owners or occupiers (every practicable facility being afforded them), within a reasonable time, scarcely to be doubted.

Much has been said, in Parliament and elsewhere, in favour of a road from Westminster to London Bridge, connected with the formation of the new embankment on the Middlesex side of the river. Such a work might, no doubt, be practicable, but would be attended with great expense, and perhaps interruption to the wharf business. If this be the case on the Middlesex shore, it might be possible to construct such a road upon the new embankment of the Surrey shore, similar to the present quay-road in front of the Penitentiary at Millbank. The new road, being united to London by means of all the bridges, would afford facilities for recreation or business, communicating as it would, by the shortest line, with all the southern railways, &c. Whatever else, however, may be done in this matter, safe and convenient piers for landing and embarking steam-boat passengers (projecting as little as possible into the river), at all the bridges and other most accessible public places or thoroughfares on both banks, should form an essential part of the new arrangements, and the present most objectionable structures be removed as the proposed safe and convenient piers could be provided.

Below London Bridge the principle of the improvement of river navigation by means of contraction has been fully exemplified. But for which, together with the proper tiering of ships, which is but another application of the same principle, and the excavations continually made by the Trinity Corporation, it could not have been possible for ships of such draught of water to have access to the London and St. Katharine's docks, and throughout the port, as is the case at present. As, however, these contractions and embankments have not been systematically constructed, they admit of considerable addition and alteration in several places, such are described on the plan, and may be connected with the necessary removal of shoals and mud banks, laying down additional moorings (such as for colliers or other vessels at New Crane, where numbers of West-Indiamen were formerly moored, which has been proposed but not executed, for want of funds), and various other essential improvements, which will, no doubt, be much better detailed by the other professional gentlemen engaged in this important survey. I beg leave, however, to add my firm belief, founded on long experience and local knowledge of the river Thames, that the shores at Greenwich, Woolwich, Gravesend, and several other places, are very capable of the alteration and improvement pointed out by the lines which have now been laid down, and which would be equally advantageous to the owners and occupiers of the frontages, and to the navigation of the river.

I am, &c.,
STEPHEN LEACH,
Clerk of City's Works on Thames Navigation.

To The Worshipful Committee of Thames Navigation.

No. 280.

Rowland, on the Improvement of the River and Port.

No. 280.

MR. ROWLAND'S *Report on the Improvement of the River Thames and Port of London.*

GENTLEMEN, *Greenwich*, 1st *January*, 1842.

The plans for the improvement of the river Thames, made under the direction of your committee, have been brought together with great labour and attention; they show the general outline of the river and shoals, and a line is drawn in your plans, showing the opinion of the Committee of Survey,[*] the

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[*] Mr. James Walker, F.R.S., Civil Engineer; Captain Frederick Bullock, R.N., Maritime Surveyor to the Lords Commissioners of the Admiralty; Mr. Nathaniel Saunders, Water Bailiff, and Sub-Conservator of the river Thames; Commander John Fisher, R.N., Principal Harbour-Master of the Port of London; Mr. Stephenson Leach, Surveyor and

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advantage of an uniform line of embankment on both sides of the river, from Chelsea to Gravesend, a distance of about 35 miles, having a tendency to remove nuisances, shoals, mud banks, obstructions to the navigation, and encroachments into the river beyond a fixed and permanent line of embankment.

From time immemorial shoals and mud banks have existed in the river Thames; they have materially increased of late years. Many complaints have been made by the shipping interest of the port, and I trust in a short time funds will be found to enable the Corporation to remove them. Once removed, and the plans now submitted to your consideration carried into execution, these shoals could not form again.

The first question is, "the cause of shoals and mud banks forming in the channels and other parts of the river?" The primary cause is the clay, earth, soil, sand, and rubbish brought into the stream by the drainage and sewerage of London, and the whole line of country along its banks.

The valley of the Thames and its contributary streams is said by Mr. Milne, engineer (in a report, 1797), to drain 3870 superficial miles of land. In a commercial point of view, this drainage is the most serious evil to the navigation of the river Thames, and is the principal cause of the shoals and mud banks, the deposit being the material of which they are composed, the lighter portion being held in suspension; the sand and heavier parts are driven by the force of the tide into eddies, or into sluggish water, where they settle and form the inconveniences complained of.

Against the practice of sewers and drains being brought into the river, there has not been shown any visible means of relief; on the contrary, as London and its population increase, an additional quantity of soil must be expected.

There are many other causes which add very considerably to the formation of shoals, namely, the large quantities of sweepings and refuse from warehouses and dwellings on the banks of the river, sweepings from the ships, straw and rubbish; thousands of tons of coal dust and ashes are thrown overboard from the steam boats in the course of each year. The mud which has been admitted into the docks with the tide forms a settlement, and hence a mud bank in the docks; this is obliged to be removed at a great expense to the dock companies, by contractors, whose object is to fulfil the contract at the cheapest rate; the barges when filled are sent down the river to be unloaded, and the mud wheeled on shore; this being a dirty and tedious process, the labourers find it more convenient to throw it overboard. Night does not always spread her mantle over the proceeding, but it has been openly thrown overboard even by daylight. A Mr. West, of Poplar, is now in prison for the offence, which has had a beneficial effect in preventing a repetition of the nuisance for some months past. Another method of getting clear of mud which accumulates under wharfs and in dock entrances is by a large scraper attached to the stern of a small steam boat: the steam engines are set to work towards the stream, and the scraper and mud are drawn into the river; this operation is repeated until the proper depth of water is obtained.

Most of the dock companies are permitted under the authority of their Acts of Parliament to open their sluices, and scour the entrances to the docks, but when mud is allowed to accumulate to such a substance, that their force of water will not wash it away, they should be compelled to remove it by lighters, and not force into the river in heavy masses.

At the West India Dock a reservoir is constructed, into which water is pumped, and the mud is allowed to settle; the dock is supplied with the clear water, and the mud discharged into the river again through a sluice, near to the entrance at Blackwall.

For all these nuisances and annoyances, and many others of a minor consideration, a legal remedy may be applied, and it might be made part of a policeman's duty afloat and ashore to take into custody and bring to justice all offenders.

The next cause of the formation of shoals arises from the ships and vessels lying in the river, some at fixed moorings, others with their anchors down. Commencing at London bridge, the depth of water down to the Tower, where ships are moored, is much the same; below each tier of ships, the water shoals, and again deepens at the Tower tiers; below Iron-gate tier the water again shallows, until the dredging of St. Katherine's Dock Company preserves a good depth to their docks. The water becomes shoal again, and deepens a little at Union tier, when the tiers cease on the north side of the upper pool, and a shoal commences. On the south side of the river from London bridge the same is the case down to East-lane, then shoal water down to the platform; the water then deepens down to Church-stairs tier, when a shoal is formed immediately below it; in succession are four tiers of colliers and another shoal, and mud of a very extensive kind, called the King and Queen mud.

On the the north side of the lower Pool the largest colliers lay in five tiers down to the Regent's Canal, in water varying from 14 to 18 feet; directly below the tier a hard shoal is formed of considerable extent, and the reach below is full of shoals. Thus it clearly proves, that where ships are anchored or moored in a tide way, the stream is obstructed, and when the bottom of the vessel is near the ground, an artificial current is formed underneath, of greater rapidity than the stream above, sufficiently strong to disturb and remove the sand and silt, and consequently the water is deepened. The operation is continued at each tier in the river, until there is no additional force or action to impel it forward. This always commences immediately below the tiers, unless there is a fair set of tide flood and ebb to carry it further down; so that the bed of the river where ships are moored is furrowed according to the draught of water and position of them, and causes a large quantity of silt and sand to accumulate—hence shoal water.

The creeks leading into the Thames are another source of injury to the river, voiding an immense quantity of shoalable matter. See the entrances into St. Saviour's Dock, Limekiln Dock, Deptford Creek, Bow Creek, Ham Creek, Barking Creek; and off the land sluices there is no exemption—they all have mud and shoals at their entrance a long way into the river.* The superintendence of the police in the upper creeks is particularly required both by day and night.

The introduction of steam vessels, and the wash from the paddles has been a source of great private distress to many wharfingers, whose property has been undermined by the repeated wash of the water, but attended with much public good by cleansing the shores of the river. In many places where vessels used to lay in the mud for sale, or for their winter quarters, there was six feet depth of mud; now it is fine gravel. In some places, as at Greenwich and the Folly House, the gravel will run up the shore, and recede as at Deal beach—the constant action keeping the shore clean. In the summer the upper part of this office-causeway is covered with shingle.

The constant wash from the steam boats on the banks, but more particularly on the points of the river, has loosened the earth on the Foreland, and large quantities of earth have fallen into the stream, in some places 30 feet from the original frontage.†

A plan of the point opposite Blackwall, and a report on this subject were submitted to your committee

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Clerk of the Works of the Thames Navigation Committee; Mr. William May, Draughtsman to your Committee; and the Harbour-Masters, Mr. Charles Rowland, Lieutenant William Stone, R.N., Mr. Charles H. James, on their respective stations, assisted by Mr. James Francis Firth.

* In the reign of Queen Elizabeth, men of war used to lay in Deptford Creek. In the reign of Henry VIII., Harry-Grace-a-Dieu, of 1000 tons, fitted out at Barking, and now there is scarcely room and water for a fishing smack at high tide.

† The river walls are under the inspection of Commissioners appointed by the authority of Parliament, having a Marsh Bailiff under them, whose duty is to examine and report from time to time any dilapidation; the land lost from the shore before mentioned is without the river wall, and called the Foreland, over which the Commissioners have no control until their wall is in danger. The City Solicitor will be the best judge of the measures necessary to prevent this additional nuisance to the river.

APPENDIX B.

LONDON.
River Thames.

No. 280.

Rowland, on the Improvement of the River and Port.

last year, with a desire that the Lord Mayor should call the attention of the Kent Jury to the subject at the Court of Conservancy.

The circuitous winding of the river, and the course taken by the tide flood and ebb, is another cause for the formation of shoals. Wherever the stream of the tide crosses ebb and flood, there is deep water; where the influence is only flood or ebb tide, there is a shoal.

The current, in the distance between London Bridge and Cuckhold's Point (two miles), is diverted by the shipping from its natural run, and therefore let the first example commence at Cuckhold's Point. The ebb tide sets over to Limehouse Hole tier, away from the point, forming an eddy, or at least a sluggish tide, under the point, and a deposit is formed of every description of filth, sand, mud, and coal-dust. The flood tide runs fairly through the upper part of the reach into Duke's shore, leaving the deposit of the ebb tide untouched, and a very extensive shoal is the consequence.

The next point, below Mellish's Wharf, the tide takes the course, ebb and flood, round by Deptford; hence the deep water at that place, and a shoal of mud round the opposite point. The Whiting Shoal, in the middle of Limehouse Reach, has been in existence for centuries; its danger to navigation caused great discussion in the reign of King Charles the Second. It is formed with a crust, called Plum Pudding Stone, on the outside, similar to the Limehouse and Blackwall Rocks, which, when broken away, the shoal vanished. At Blackwall there is 20 feet of water where the rock stood.

At Saundersness, a sharp point of the Isle of Dogs, opposite Crawley's Wharf at Greenwich, the tide, ebb and flood, takes a course nearly in the centre of the river, leaving an eddy above and below; thus a shoal of filth, as at Cuckhold's Point, is formed, which extends a long way out into the river, leaving a navigable passage of about 120 feet in width, between it and Crawley's Shoal, which extends from the wharf towards Saundersness. The ebb tide then takes its way down the eastern side of Blackwall Reach, to the West India Docks; takes a northerly curve round by the Brunswick Wharf, and enters Bugsby's Hole. The tide takes the same course, ebb and flood; the effect of which is deep water in the course of the tide.

Vessels of a large draft of water used to moor round by Blackwall: few have lain there for many years, and the water has rather increased, leaving mud and silt in the eddy and slack tide, from Saundersness to the Folly House; the Gun Shoal (sand) to the West India Dock entrance; round Blackwall Point, sand and mud. The same result will be found throughout the river. But it is worthy of remark, that in Long Reach, where there is nearly a straight line of embankment, and run of the tide, ebb and flood, for four miles, the water is deep throughout, without a shoal.

There are in places patches of shoals: the most dangerous is in Blackwall Reach, in the middle of the river, in a line from the Chalk Stones and the Sluice, on the Isle of Dogs. It is called the Middle Ground, and lies north and south, about 50 feet wide, and 200 feet long, with 7 feet on it at low water. Feels to be rock and sand, with deep water to the eastward and westward; nor can I account for it, unless by its being part of an old shoal, the loose matter being washed or worked away, and the hard substance left. At the head of Rugsby's Hole and Woolwich Reach, there are several such shoals. Also a shoal extending from the sluice below Charlton Wharf, 400 feet into the river, in the middle of Section No. 1.

There was a similar shoal to the last mentioned, about 200 yards below it, called Cooper's Shelf; this shelf was supposed to stop the force of the ebb tide from running down the river in front of Woolwich Dock Yard, thereby preventing the usual scouring of the mud away.*

The soundings, marked on a plan laid before Parliament, and made under the orders of the Elder Brethren of the Trinity House in 1750, when compared with the soundings of the present day, show that the water has considerably increased in most parts between London Bridge and Blackwall, if the same standard of low water is taken.

I herewith insert, as an Appendix, "A statement of the Soundings of the River Thames, from London Bridge to Blackwall, taken at low water, March, 1796, by Mr. James Foulds, by order of the Committee of the Port of London."

I have added a Return, showing the soundings taken by myself in 1825, and the soundings lately registered for the Port Chart, so that your Committee may compare, at one view, the soundings of 1796, 1825, and 1836, taken across the river at the same places.

There were more soundings taken by Mr. Foulds than shown in this Return, but as many of the places are called stations, and the precise points cannot be ascertained, I have selected those about which there can be no doubt.

By these soundings it appears, that since the removal of old London Bridge, the water in the Pools has considerably decreased, except in the channels.

At the request of the owners of East Indiamen, the Trinity Corporation laid down moorings, with buoys, at a great expense, for their accommodation, which were completed in August, 1812.

Shortly afterwards steam-tugs were introduced, and the moorings thus laid down fell into disuse, and they were removed in 1825.

The depth of water in this spot has decreased from 22 feet to 14, owing to the accumulation of sand and mud.

The Corporation of London, by the 39th Geo. III. c. 69, sect. 37, are restricted in their control over the moorings to between London Bridge and Bugsby's Hole.

The inequality of the breadth of the river is another cause of shoals and banks. Commencing with the Collier Pool, at Globe Stairs, which is 880 feet; quarter of a mile below, at Cuckhold's Point, 1,020 feet; the river continues to widen to 1,390 feet; the water that was confined at Globe Stairs suddenly expands over a broad surface, the tide is deadened, and eddies are formed at the point and down the west shore of Limehouse Reach. For a distance of a mile and a-half are mud and shoal water, leaving the Whiting Shoal in the middle of the reach.

At Deptford the water is again contracted to 1,030 feet, and widens at the lower part of Greenwich, where it is 1,350 feet; hence the shoal water on the point, and at the head of Blackwall Reach. The river to Blackwall maintains a fair average width. At Blackwall it is contracted to 1,080 feet, and expands to 1,550; hence the formation of shoals on the point and in Bugsby's Reach. The same argument will bear in other parts of the river, but the above is enough to explain a cause and effect.

This disparity in the breadth of the river, in a distance of six miles, is most injurious by the formation of shoals; for at every turn of the river eddies are formed, which produce shoal water. If the shoal is removed from a point, it returns again almost with the next tide. It is not uncommon to see, from day to day, in the summer time, 15 barges from 40 to 50 tons each, taking sand and ballast from the point opposite Blackwall; and a larger number on Bull's Point, opposite the Arsenal. On the return ebb tide the holes are all filled up again, and the hill on the point is as high, and with no appearance that a shovelfull had been removed.

To remove the extreme points, and with the material fill up the inner circle of the river or bights, would cause the tide to have a more direct influence on the bed of the river, and force the sand and silt down to the deeps towards the sea.

Mr. Elmes, the Port of London surveyor, was directed by your Committee, on the 22nd of June, 1838, to take a survey and make plans of the principal shoals in the River Thames; and I do not deem it out of place to refer your Committee to the same.—*See* Appendix.

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[*] On the application of the Lords of the Admiralty to the Elder Brethren of the Trinity House, it was removed by their machinery at a cost of less than 300*l.* 25 to 30 ships now constantly lie in water varying from 14 feet to 20 at low water, and is a valuable addition to Section No. 1 for colliers under the Bye Laws of 1833.

APPENDIX B.

LONDON.
River Thames.

No. 280.

Rowland, on the Improvement of the River and Port.

Every subject which has for its object the improvement of this fine port, will not be irrelevant to the matter under consideration; for whatever is beneficial to the navigation of the river must, in its degree, advance the commerce and prosperity of the City of London; and feeling as I do the importance of the subject, I trust I shall not be deemed intrusive in extending my remarks.

The Port of London has been for centuries the seat of commerce for the world, and from which most enterprises, scientific and commercial, have originated, enriching the country, the merchants, and citizens.

It would not be a work of very great labour, there being so many authors on the subject, to show the rise and extent of the commerce of London, from the time when Billingsgate and the legal quays afforded sufficient accommodation for the foreign trade of the port, down to the present time; but the present extent of the trade, and increase of shipping discharging their cargoes in the river, will not allow an adequate space in the river for the purposes of the improved system of navigation by steam, at the same time to accommodate traders which deliver their cargoes in the stream of the river.

The extent of the trade and consequent increase of shipping in the port, and the complaints of the ship-owners of the want of accommodation and loss by the crowded state of the river in 1796, 1797, 1798, and 1799, caused the Legislature to make a searching inquiry into the subject. During this investigation it appeared that the trade of the Port of London was, in

A.D.		Vessels.	Tons.
1700.	Vessels employed in the coasting trade	5,562	278,100
1702.	British ships in foreign trade	839	80,040
,,	Foreign ships	496	76,995
	Total	6,897	435,135
1750.	Vessels employed in the coasting trade	6,396	511,680
1751.	British ships in the foreign trade	1,498	198,023
,,	Foreign ships	184	36,346
	Total	8,078	746,049
1797.	Vessels employed in the coasting trade	10,175	1,205,650
,,	British ships in foreign trade	1,426	380,392
,,	Foreign ships	1,843	226,856
	Total	13,444	1,762,898

The whole commerce of the Port of London will be found in the Appendix Table.

All the ships at this period were moored in the River Thames, and there discharged their cargoes, and such was the crowded state, that a vessel was frequently a week in getting down from the quays to Blackwall.

Wet docks alone afforded the remedy, and there were numerous and ingenious plans submitted to the Committee of the House of Commons, and on the 29th July, 1799 (39 Geo. III. c. 69) was passed and intituled "An Act for rendering more commodious and for better regulating the Port of London." This Act empowered the Corporation of London to make a navigable canal across the Isle of Dogs, called the City Canal, to appoint harbour-masters, and make bye laws for the more convenient navigating and mooring of ships. The Act also empowers the Corporation to purchase the existing rights of all mooring chains between London Bridge and Bugsby's Hole, so that no obstacle should exist to a proper control in the distribution of their powers.

By the same Act of Parliament powers were granted to the West India Dock Company to construct the West India Docks for the accommodation of vessels in the West India trade, with a capital of 1,200,000*l*, and making it compulsory for 21 years for all ships engaged in that trade to the Port of London to discharge their cargoes therein.*

The West India Docks were opened for business on the 2nd of September, 1802, and the compulsory power expired 1823.

This was the first step to relieve the river. The import dock was constructed capable of receiving 204 ships, the export dock 184, and the basin 48, making a total of 426. In 1803, 374 ships, 113,114 tons, entered the docks, ; 1821, 550 ships, 156,723 tons.

The next improvement to the port, called the City Canal, was constructed under the direction of the Port of London Committee, for the transit of ships from Limehouse to Blackwall, across the Isle of Dogs. It cost 168,812*l*. 13*s*. 11*d*., and was opened for business on the 9th December, 1805. For the first three years, by the authority of Parliament, all vessels were to be permitted to pass through the said canal free of expense; and in the first year after the canal was opened to the public, there were 1647 ships of 284,574 tons, and 5950 craft. When the tolls were imposed for the transit but few vessels availed themselves of its convenience, and it was principally used for vessels to lie up in, and some few to fit out. It having failed in its object as a canal of transit, the Corporation applied to Parliament, and, by the 10th Geo. IV. c. 130 (19th June, 1829), it was sold to the West India Dock Company for the sum of 100,000*l*., and it is now called the West India South Dock, with a dock for timber connected with it.

Government having, in 1799, sanctioned the principle of compulsory clauses, plans for the improvement of the port by docks were brought forward in vast numbers.

The London Dock Company obtained an Act of Parliament (39 and 40 Geo. III. c. 47), 20th June, 1805, for constructing a dock capable of accommodating 250 ships, with a capital of 2,000,000*l*. (now 3,200,000*l*.), with a compulsory clause that all vessels laden with wine, spirits, tobacco, &c., should deliver their cargoes in this dock for 21 years. This expired in 1826.

The East India Dock Company at Blackwall followed (43rd Geo. III. c. 126), 27th July, 1803, with a compulsory clause that vessels laden with produce from the East Indies and China should deliver their cargoes there for 21 years. It was opened for business on the 4th August, 1806; which clause expired in 1827. The East India Company alone employed 54 ships of 46,562 tons. 300,000*l*. capital, and capable of accommodating 126 ships.

The Commercial Docks were constructed under the authority of 50 Geo. III. c. 207, 20th June, 1810, for timber, wood, and other merchandize. Opened for business in 1812. Capital 300,000*l*.

The East Country Dock Company obtained their powers under the 51 Geo. III. c. 171, 15th June, 1811, for completing and maintaining the East Country Dock (it was formerly called the Greenland Dock), for timber and east country produce. Opened for business in 1813. Capital 60,000*l*.

The Grand Surrey Canal Company obtained an Act (41 Geo. III. c. 31), 21st May, 1804, for making a navigable canal from the Gun wharf, Rotherhithe to Kennington Common, to enter and communicate with the River Thames at Cumberland Gardens, Vauxhall. This has never been completed. Acts of Parliament were afterwards obtained (47 Geo. III. c. 80. 48 Geo. III. c. 99, and 51 Geo. III c. 170) for connecting the canal with the Grand Surrey Canal Docks for timber and other merchandize. Opened for business . Capital 250,000*l*.

From the Grand Surrey Canal a branch called the Croydon Canal was constructed under the 41 Geo. III.

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* By the 48th Section, four aldermen and four common councilmen were to be Directors of the Company, one of each of whom to go out annually.

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c. 127, 21st June, 1801, and ran through Deptford, Sydenham, Streatham, Dulwich and Croydon. It never answered the expectations of the proprietors, and was sold to the London and Croydon Railway Company, and forms the line of railroad to the latter place. The last, and not the least important improvement, was the construction of the Regent's Canal and Dock. It was commenced under the authority of the 52 Geo. III. c. 195, 13th July, 1812, and extends 8½ miles from Paddington round the north of London, and enters the Thames at Limehouse. It was opened for business on the 12th of August, 1820. Capital 400,000*l.*

As the docks were opened for business, the shipping, in obedience to the laws, sought those places of security, and left the river almost entirely to the occupation of the coasting trade

Bye laws were then formed by the Corporation of London for the more safe and convenient navigating, placing moorings for ships and vessels in the River Thames, and for the good government of the harbour masters. 22nd January, 1807.

Thus it will appear that in a few years millions of money were expended by private enterprise in providing relief to the navigation by wet dock accommodation for the shipping, and Government advanced from the Consolidated Fund for the Improvement Act 1,631,685*l.* 16*s.* 11*d.*, of which 327,000*l.* were paid to the Corporation of London towards the construction of the City Canal and other improvements in the port, and 142,136*l.* 9*s.* 6*d.* for the purchase of the mooring chains. By these measures, and the regulation of the ships by the harbour-masters on the river, the navigation was much improved; the ship-owner, by the dock system, found his vessel in a place of security: no delay in the discharge of the cargo, or danger in the course of navigation by the crowded state of the river. The merchant and the revenue were alike protected from that system of espionage which had been practised on the river for so many years

The bye laws had the desired effect, and the river was kept in good order; occasionol inconvenience was experienced from fleets arriving at the same time, and as the trade increased, the shipping endeavoured to crowd as near to the city of London as possible, and about the year 1820, the river trade had improved to such an extent that measures were introduced to detain colliers at Blackwall and other places out of the pools.

The introduction of steam-boats on the river, in 1814, and their increase to this period, present a new feature in the system of navigation. Sailing vessels used to drop up on the flood-tide and down with the ebb, and this principle was considered as a rule of the river; vessels that navigated against tide did so at their own risk. But the introduction of steam-boats as tugs altered the system altogether; not only did the steamers themselves travel against tide, but were sufficiently powerful to tow large vessels with them.

In 1821, a Committee of Inquiry on the Port of London—third report, Foreign Trade. The subject of the difficulties of navigation by the increase of shipping was officially brought before the public. The St. Katherine's Docks were proposed, to reduce the number of ships using the river. and as the compulsory clauses of 21 years to the dock companies would shortly expire, it was said that this dock would prevent a combination of the old establishments, and bring the commerce of the port nearer the heart of the city. Many other plans of docks for colliers and coasters were submitted to Parliament. That proposed on the Isle of Dogs was submitted and matured by myself: but owing to the change of government opinion of "no compulsion," the whole of them were abandoned, but the St. Katharine's Docks, which were established by the 6 Geo. IV., c. 105, 10th June, 1825, with a capital of 1,352 752*l.*

In 1798, the dock mania year, the great improvements to the port were first set in motion. There appeared by the official return for that year, 1797 colliers; coasting and foreign trade, 13,444 ships, 1,762,896 tons.

In the bubble year of 1825, the return to the end of the year:—

	Vessels.	Tons.
1824. Coasting and colliers	18,330	2,242,590
„ British and Foreign trade	3,132	607,106
„ Foreign trade	1,643	264,098
„ British ditto	513	56,392
Total	23,618	3,170,186

	Ships.	Tons.
Of these, the docks accommodated in the East India Dock	117	74,206
West India ditto	540	149,061
East Country ditto	48	12.871
Commercial ditto	505	131 223
Grand Surrey Canal	201	48,734
London Docks	1,348	214.481
Total	2,759	630.576

Total for river accommodation, 20,859 ships, of 2,539,610 tons.

The coal trade had increased, from 1797, to 3676 vessels, of 656,000 tons.
„ „ in 1825, to 6564 vessels, of 1,856,606 tons.
The further increase . . 1841, to

Thus the increase of the trade of the port, in 27 years, to be accommodated in the stream of the River Thames, exclusive of all the wet docks, was 7415 ships of 776,812 tons more in 1824 than 1797, which was effected by the bye-laws of the corporation of London.

The St. Katharine's Docks were opened for public business, 25th October, 1828. Vessels of a small burthen had hitherto navigated through the pools over the shoals, and in the narrow passes of the river, but on the opening of these docks, a navigable water-way was required, to allow ships of 1000 tons to be towed up by steam to the new formed docks. The Company complained of the inconveniences to navigation by the number of vessels moored in the river, of shoals, and other impediments.

A modification of the existing regulations took place, and application was made to Parliament for extended powers, and obtained by the 10th Geo. IV., c. 124, 19 June, 1829, under which Act new bye laws were passed by the Common Council, and confirmed 24th September, 1829. The alteration principally consisted in regulating the number of coal vessels to lie at the tier in the lower Pool, and to preserve a navigable passage through the Pool to St. Katharine's Docks, of 300 feet.

A flag was established at the Harbour Master's Office, Greenwich, half red and half white, by which signal no vessel, coal-laden, could proceed into the Pool without written permission from a harbour-master.

By these regulations the navigated passage through the Pools was much improved, but from the great increase of shipping in the coal-trade, Deptford, Greenwich, and Blackwall became the general rendezvous for the colliers: thus the inconvenience of a crowded navigation was extended from the Tower down to Blackwall.

The septennial renewal of the Coal Act called for parliamentary investigation, and in the course of examination, these difficulties were represented to the Select Committee, who, in making their report to the House of Commons, recommended that laws should be established for the regulation of colliers within the port of London. The corporation, in consequence of the powers thus created, with the approval of the Board of Trade, produced the bye-laws for regulating vessels laden with coals, in and near the port, dated 21st August, 1838.

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These bye-laws gave effect to the plan of placing colliers into sections, in different parts of the river down to Northfleet, and is considered by all persons cognizant with the subject, to be the best and most efficient remedial method of preserving the navigation.

When I was appointed harbour-master, in 1821, all the colliers were, by an order of your Committee, permitted to the Pool; a subsequent order confined the number to those ships sold and metered; the remainder were detained at Greenwich. In 1829, the tiers were limited to specified numbers, the Harbour Master's Office, at Greenwich, established, and the colliers were permitted to pass up to the Pools in rotation of arrival. The residue were detained at Deptford, Greenwich, Blackwall, and Bugsby's Hole.

By the bye-laws of 1838, colliers were permitted to the Pool in rotation of sale, and the remainder detained in sections, thus:—

Bugsby's Hole, No. 1, 65; North Galleons, No. 2, 15; South Galleons, No. 3, 10; Halfway Reach, No. 4, 20; Long Reach, No. 5, 150, on emergency increased to 200; Greenhithe, No. 6, 75; North Fleet Hope, No. 7, 75; total, 460 sail; but, notwithstanding this detention of floating warehouses, at periods the arrivals have been so numerous, that many have been detained below Gravesend.

Yet this is but a measure to lessen an evil. The question is frequently asked, "Why, in a navigable river, where the width is not more than sufficient for the purposes of navigation, and where, in places, from shoals and banks, it is not wide enough, that near 10,000 sail of colliers in the course of the year should be permitted to keep their coals warehoused in the river, and afterwards discharged into barges in the fair way of the stream, to the impediment of a navigation so much required as a highway, and where the practice is an injury to the general trade and commerce of the port?"

Steam is now the moving power by which a great part of the home and foreign trade of this port is carried on, in vessels from 20 to 1000 tons burthen, navigating up and down the river at all hours of the day and night, against wind and tide. It requires no argument to prove how essential it is to the well doing of this branch of commerce, that every exertion should be used by the authorities to remove the impediments which now exist.

The practice of mooring ships in the set of the tide and deepest water (to prevent them from taking the ground at low water), is an obstruction to the most convenient and proper course to the progress of navigation.

Whatever regulations may be made for the shipping to lie and discharge on the stream, none can be permanently effective. The remedy must be wet docks.

There is no authentic account of the time and cause of the embankment of the river. Tacitus tells us that, "The Britons complained that the Romans wore out and consumed their bodies and hands, in clearing the woods and banking the fens." Therefore, in the absence of better evidence, it may be presumed that the first embankment of the Thames was the work of the Romans, and that at one period the water overflowed all the marshes north and south of the river. Sir William Dugdale, A.D. 1662, gives an account of numerous commissions issued under royal authority, for stopping up of breaches, repairs, drains, sewers, and banking, from time to time, in the reign of Edward I., down to his own time.

"Cornelius Wunderdell, at his own charge, inned, embanked, and recovered 'Wapping Marsh,' in the county of Middlesex, in A.D. 1543." (See Parliamentary papers).

The marshes between Bow and Barking in Essex, according to Kilburne, were rescued from the "sea" by Haimo, sheriff of Kent, and others, in the time of Edward the Confessor, each receiving a grant of the land as his share. It is also stated that the lot apportioned to Haimo, near 500 acres, was attached to his jurisdiction in Kent. This tale is very probable, for there is at the present time, as part of the parish of Woolwich, by recent survey, 399 acres and 37 poles on the Essex side of the river.

Breaches of the banks have not been frequent of late years. In 1236 the marshes between Greenwich and Woolwich were described "all on a sea, wherein boats and other vessels were carried with the stream, so that, besides cattle, the greatest number of men, women, and children were drowned."

Commissions of Inquiry were ordered, 21st Henry III., and persons appointed to repair the "breaches made in the wall of the river," together with the sluices and ditches connected with the marshes.

Another great breach, 17th Henry II., in the marshes between Greenwich and Woolwich; again in the time of Edward III., A.D. 1336. In the reign of James I., it is stated that many acres have never been recovered.

At a place called the Chalk Stones, in Blackwall Reach, there was an extensive breach, and the spot is called the "Horse Shoe Breach:" the bank is not particularly safe now.

In 1279, the abbot and convent of Lesnes, between Woolwich and Erith (the ruins of the convent are yet in existence), made an engagement with a "foreigner" to recover the lands between the convent and the river, to be paid by a portion of the land so recovered. Again complaints were made in the 22nd Henry VIII. and 5th Elizabeth. (Grose's "Antiquities.")

For the river wall between Woolwich, Erith, Lesnes, and Fauts, Mr. William Burrell obtained an Act of Parliament, 27th February, 1606, for inning and winning certain marsh grounds to enable him to complete it, by which Act he was permitted to dig where he pleased, provided it was not within 20 rods of any wall. His reward was to be one-half the grounds recovered at 1*d.* rent per acre, in free soccage of Edward Cooke, Esq., his heirs, administrators, or assigns.

In Half-way Reach in Essex, 36th Elizabeth, 13th May, Dagenham Creek was ordered to be inned and banked, but in 1621 it broke in and covered the whole marsh with water.

The bank of the river was made good by Cornelius Vermuden; but the owners of the land neglected to pay him. Upon petition, a commission was issued, 1st Carolus, 1st August, to inquire; when he was awarded a parcel of land as compensation under the authority of 13th Elizabeth, c.

The great Dagenham breach, which occurred 17th December, 1707, by the blowing up of the sluice, was 300 feet long, and in places 20 feet deep. Several attempts were made to stop the water, but it was not completed until 1724; the charge and expense amounted to 44,472*l.* 18*s.* 8*d.*

In 1706, 16th February, the Essex marshes were overflowed, and a number of cattle drowned.

From the quantity of water that drained over the banks of the river into the marshes on the 18th October last, it is evident that the river walls should be raised and strengthened on the Isle of Dogs, for a distance of 300 feet along the bank near the Folly House. The tide was higher than the wall, and a perfect cascade fell over the inner side of the bank; if there had been a weak place on that distance, the Isle of Dogs would have been under water, and the loss of life and property dreadful; the average of the whole marsh being 9 feet below the mean high water mark spring tides by my own survey in 1824–5.

The mud, earth, and vegetable matter brought into the river on the opening of the marsh sluices must be considerable.

The object of the above detail is to shew that our forefathers had no notion of fixing a precise limit to the banks of the river, so as to direct the course of the stream to cleanse itself, or to adapt it for a navigation or any defined purpose, the object then being to protect the land from the water.

The present secure state of the banks of the river is generally attributed to King William, who ordered labourers from Holland over to England for this express purpose, and they have continued to be kept in repair under the Commissioners of Sewers. In the various districts along the shores, at the construction of the West and East India Docks, and at the present time, where the Trinity ballast engine is at work in Barking Reach, large quantities of timber, hazel bushes, nuts, acorns, are dug up.

The royal forests were permitted to be cut for the repair of the banks. The abbess of the nunnery at Barking had licence to cast wood or timber through the "forest from Gouldhurst Wood to La Claye, for the repair of breaches occasioned frequently by the sea."

The same privilege was given to the abbots of Bermondsey in Surrey, Lesnes, and Saint Augustin of Can-

Rowland, on the Improvement of the River and Port.

terbury, Kent; the prior of St. John of Jerusalem, Essex; the abbots of Stratford, and of Graces near the Tower, Middlesex.

There cannot be a question raised against the general utility of the proposed embankment of the river Thames. The plan of Sir Cristopher Wren for rebuilding the city of London, after the great fire in 1666, contemplated the project of one uniform line of embankment, commencing at the Tower of London westward to the Temple. The original drawing is in the Library of All Souls College, Oxford.

Messrs. Telford and Douglas, engineers, proposed an embankment on both sides of the Thames; they say it would scour the bed of the river, improve the navigation, and enable six depôts for coals, and a public market.

Mr. Robert Milne, in his Report, 30th May, 1800, says:—"Partial embankment should not be allowed on any account, and a clear, not a negative power should be constituted to form and establish those only which may be useful to the general good. The bed of the river between Westminster and London Bridge might be kept clear by the increased power and velocity of the stream alone, if it was improved by these means, and by some expense being laid out to increase the depth to a more equal uniformity through the whole. The particles of mud and light matter in water, while it has a certain degree of velocity, are deposited when it comes to a place where it moves with less and approaches to a quiescent state.

"By that effect all the shores in this district are from low to high-water mark covered with mud more or less, in exact proportion of great width and shallow depth. The tide on the flood would have a free course, and enlarge the quantity of inland water, but the water on its return would scour out the sand and mud and other filthy material from the sewers, and from the sluggishness of the stream is now allowed to accumulate."

I could find opinions similar to the above from the evidence of Mr. George Dance, Mr. Rennie, Mr. Ralph Dodd, Mr. Wyatt, and engineers of eminence. I have already far exceeded the bounds I had prescribed for myself at the commencement of this Report, but I hope the committee will excuse me for the lively interest I feel on the subject, and on every project which I conceive will tell to the improvement of the navigation of that river which I have been connected with for more than 20 years.

An improvement of this magnitude must naturally be a work of time. A well-defined plan mutually agreed upon by the Government and the Corporation of London under the authority of Parliament, with funds to the amount of about 5000*l.* to 10.000*l.* per annum, for the removal of shoals and mud banks, and to pay for the refuse ballasting of the corporation of the Trinity House, would in a few years make a most beneficial alteration in the navigation of the river.

In every future improvement contemplated by any wharfinger or occupier of premises on the banks of the river, reference would be immediately made to the plan, and the work would be constructed accordingly.

The Greenwich pier was constructed solid to the extent of 365 frontage and 85 feet from the old bank of the river. The required depth of water was made in the first instance by dredging, and there has been no accumulation of mud or silt, since the tide keeps it clear.

	oz.	dwts.
In a spring tide the quantity of sediment held in suspension in the Thames water—		
1 gallon taken from the middle of the river at high water	0	18
1 ,, taken at the same time near the shore	1	1
1 ,, taken from the middle of the river at half ebb	0	16
1 ,, taken at the same time in shore	1	0
In a neap tide—		
1 gallon taken from the middle of the river at high water	0	16
1 ,, taken near the shore	0	18
1 ,, taken from the middle of the river, half ebb	0	11
1 ,, taken from near the shore at the same time	0	12

The water is generally very clear at low water.

These experiments show that there is more material held in suspension in a spring tide than there is in a neap tide; because the spring tide runs with more rapidity over the ground, and scours away the mud from the shores. Their eddies are more turbulent, which prevents mud from settling on the points.

The strength of the tide varies very much in the river Thames, and is influenced by winds and land waters. A strong southerly wind makes the ebb tide run down longer than usual, and checks the rise of the flood tide. A strong wind from the northward brings the flood tide earlier, with a lofty high water. A sudden shift of wind from the northward, as on the 18th October, 1841, with a spring tide, is sure to produce a lofty tide.

The comparative velocity or run of the flood tide to the ebb is as 5 to 7½; when the land waters are out, the proportion is not more than 3 flood to 9½ ebb.

Under ordinary circumstances at this season of the year, a spring tide will be divided thus:—It was low tide at Greenwich, 30th December, 1841, at 10. 40 A.M., being two feet below the Trinity standard of low water.

	Feet.	Inches.
First hour of the flood tide it lifted	5	6
Second	10	7
Third	15	6
Fourth	19	6
At high water, 3·20 P.M.	20	9

The flood tide occupied 4 hours 40 minutes with slack tide at low water, and high water of 50 minutes.

The land water causes the stream to run down longer and stronger on the ebb tide, carrying away the filth which the flood only partially returns with. In the winter time this has a beneficial effect on the loose shoals on the points of the river; the upper side of Cuckhold's Point in December, 1841, was two feet, Saunders Ness three feet, and Blackwall Point about two feet six inches lower than in the summer time. The removal has disclosed to the poor large quantities of coals, which are dredged up from under the points for months past below Saunders Ness; upwards of 50 boats have been thus employed daily raising from four to six bushels each, in the eddy formed by the ebb tide, which is sold at 1s per bushel. The shoals which press most heavily on the consideration of the Committee for removal are, the Whiting Shoal, in Limehouse reach, the Middle Ground in Blackwall Reach, a small shoal at the head of Bugsby's Hole, and Ham Shell in Woolwich Reach.

To obtain the scour required in the front of Woolwich dock-yard, to remove the accumulation of mud and deepen the water, would be to remove the point called Hook Ness, opposite the mill in Bugsby's Hole, and the earth or excavation might be advantageously carried into the curve or bight of the reach; this would have the desired effect, and would at the same time deepen the water in Bugsby's Hole.

A light on Blackness Point, opposite Gray's, would be of great service to all vessels navigating at night. The land laying low and nearly covered at high water.

A general embankment of the river as far as the tide flows, so as to obtain a precise line of ebb and flood, would improve the bed and shores of the river, increase the depth of water through the channel, the impurities of the sewers carried more rapidly towards the sea; ships and steam-boats would navigate with less danger at all periods of the tide; the easy winding of the river would equalize the run of the tide; navigation would be facilitated further up the country by the increased impetus of the flood, extreme eddies avoided, and shoals less likely to accumulate.

I am, &c.,
CH. ROWLAND, *Harbour Master, Port of London.*

The Worshipful Thames Navigation and Port of London Committee.

Appendix B.

London.
River Thames.

No. 281.

Report to the Court of Common Council from the Thames Navigation Committee.

No. 281.

Report to the Court of Common Council, from the Thames Navigation Committee. Presented 20th January, 1842.

We whose names are hereunto subscribed, of your Committee for improving the Navigation of the river Thames and for preventing encroachments on the said river, do certify that serious complaints have at different times been made to your Committee of various projections in the river Thames, occasioning more or less obstruction to the navigation, and creating on the adjacent shores deposits of mud and silt, charged with the contents of sewers and with refuse animal and vegetable substances, equally offensive to the sight and dangerous to public health.

These projections, it appears, have been erected not only without the sanction of your Committee, but, in some instances, in avowed defiance of their authority.

In consequence of this state of circumstances, your Committee referred the same to the City Solicitor, to consider and report upon the best measures to be adopted to put an end to this growing evil. In some cases the Solicitor received directions to commence proceedings to abate the nuisance; but, having experienced some unexpected difficulties, your Committee desired him to confer with the Recorder and Common Serjeant, and other eminent counsel, as to the best course to pursue under the circumstances stated.

Many of the encroachments upon the river, against which complaints have been made, were used, some as floating and some as fixed piers, for the landing and embarking of steam passengers, and were many of them, in form and construction, similar to some which the present and former committees had been induced to permit to remain on sufferance, by reason of representations made to them that it was absolutely necessary so far to consult the convenience of the thousands who resorted to the accommodation of steam-boats for business or recreation, as to allow of piers or landing-places in such of the populous parts of the river banks as would admit of projections, without obstructing the navigation of the stream.

Your Committee received a report from the City Solicitor that it was the opinion of counsel, in which his own experience concurred, that although every one of the projections complained of was undoubtedly a nuisance, and the continuance thereof an indictable offence, yet such a growing indisposition existed on the part of the magistrates and juries to convict in cases of projections where public accommodation was favoured by their continuance as piers for the use of steam passengers, that the conservators of the river could not with safety proceed to put their authority in force, by removing the piers in question, while others, apparently under similar circumstances, were permitted to remain.

In order to place the conservators of the river in a position to execute their authority with becoming effect, it was recommended by counsel that they should immediately cause a survey to be made of the banks and bed of the river within the limits of their jurisdiction, and that a line should be laid down, beyond which all present and future encroachments upon the banks should be removed, by whatever authority and under whatever circumstances made, and regardless to whom they might belong; and, in order that the corporation might be placed upon the highest possible ground in the course they were about to adopt, the counsel recommended that engineers of high character and standing in their profession should be employed to act with the officers of the Committee in carrying into execution the proposed survey and report.

Your Committee, strongly impressed with the wisdom and importance of the advice they had received, and feeling it was their duty not to allow the existing state of things to continue without taking some decided steps to abate the evils complained of, directed application to be made to Mr. Walker, the President of the Institution of Civil Engineers (a gentleman at the head of his profession, and upwards of 30 years engaged in engineering works upon the banks of the Thames), to afford his valuable aid in the proposed survey; and they also made a similar application to the Lords Commissioners of the Admiralty, for the assistance of Captain Bullock, R.N., one of the hydrographers to that Board, and a gentleman, who, to the high reputation he enjoyed in his profession, added an intimate acquaintance with all parts of the Thames, having executed, under the authority of the Admiralty, the best plan extant of the lower part of the river, from actual survey made by himself and his officers.

Your Committee are happy to say that they were successful in both applications, and those gentlemen, assisted by Mr. Leach, the Clerk of the Works of the upper navigation, and by Mr. Water-bailiff, and the principal harbour-master, and by the other harbour-masters in their several districts, have made a thorough inspection of the river Thames through the whole extent of the city's jurisdiction; they have likewise, in conformity with the recommendation of counsel, laid down, upon plans prepared for that purpose, lines on each bank, and have accompanied the same with elaborate reports upon the state and condition of the river, its existing defects, and their proposed remedies.

Your Committee have attentively considered the several propositions which these reports contain, and are forcibly struck with the paramount importance of giving effect to many of their recommendations, if the power and authority vested in the corporation of London, as conservators of the river, shall be found sufficient for that purpose.

It should be observed that, although the lines laid down upon the plan on both sides of the river embrace improvements along an extent of line far beyond anything which it may be within the limits of many years to execute, your Committee are of opinion that if facilities be afforded, as suggested, a considerable portion, and that by far the most important portion, of the contemplated improvement, lying within the metropolitan district, may be expected to be carried into execution at no great distance of time, from the conviction which to some extent at present exists, and which is daily increasing, that a regular line of embankment would not only materially improve the river as a navigable stream, but would augment the advantages which private proprietors may enjoy from the improved condition of their property, whether used as wharfs, or, by means of dwarf-piling, occupied by coal and other craft of that description, according to the plan suggested in Mr. Walker's report: by this means, also, ornamental embankments, in connection with public buildings and private properties, may be advantageously effected.

Simultaneously with the making of this survey, an investigation has been going forward as to the contents of large masses of ancient papers, records, and documents, deposited in cellars under Guildhall, many of which were found to relate to the courts of conservancy, and to the authority of the corporation of London in past times, as conservators of the river.

The City Solicitor has reported to us that many of these documents are of immense value in show-

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Report to the Court of Common Council from the Thames Navigation Committee.

ing the powers and authorities belonging to the courts of conservancy, and in evincing the title of the corporation to the soil and bed of the river—matters of deepest import in enabling the corporation to give the required facilities to carry out such of the important objects recommended in the reports as may be deemed desirable to sanction.

Although it has hitherto been the practice of the Navigation Committee to execute the ordinary functions devolved upon them without reference to your Honourable Court for instructions in individual cases, your Committee are of opinion that the general scheme of improvement recommended by Mr. Walker, and the other gentlemen associated with him, embraces considerations of such grave and important character, that no step ought to be taken to carry them into execution without obtaining for them the fullest and most mature deliberation. Your Committee have therefore deemed it right to lay the several reports before your Honourable Court, and earnestly to recommend them to the attentive perusal of members, together with an inspection of the several maps which are signed by the engineers, and deposited in the Town-clerk's office.

Your Committee, upon the whole, are of opinion, that such of the beneficial recommendations embraced in the reports as can be carried out under the authority of the corporation, should be adopted, and that it should be referred back to your Committee, if necessary, further to confer with the counsel who have been already consulted; and, having laid before them the information of which possession has been recently obtained, that they should be called upon to advise your Committee as to the proper means to be adopted for the purpose of maintaining and enforcing the authority of the corporation as conservators of the river, and of giving effect to such of the recommendations contained in the reports as may be calculated (while the rights of private property are strictly respected), to remove the nuisances now complained of as offensive to the sight and injurious to health, and to put the river in the best condition to afford every practicable facility for its free navigation, whether for the purposes of commerce, recreation, or health.

All which we submit to the judgment of this Honourable Court. Dated this 20th day of January, 1842.

To the Right Hon. the Lord Mayor, Aldermen, and Commons
of the City of London in Common Council assembled.

No. 282.

No. 282.

Fisher, on the Thames.

Letter from Captain FISHER *on the Thames.*

Principal Harbour-master's Office, St. Katharine's,
11th January, 1842.

GENTLEMEN,

I should have made a Report to your Committee on the survey last month, but from the agreement of the parties which your Committee appointed to take the survey of the river Thames from Staines to Yantlet Creek, and from the notes taken at the time, it was arranged that a joint Report should be made; however, finding there had been separate Reports, and a deviation from that agreement, I beg leave, in a summary and as short a statement as possible, to report that the line of embankment in the plans laid before your Committee could not have been better, or made more appropriate for the improvement of the navigation and convenience of the parties occupying water-side premises on the banks of the river.

I perfectly agree with Mr. James Walker's Report; and if carried into effect would greatly assist in creating a uniform set of the tide, and eventually would be the means of preventing shoals from forming in different parts of the required river.

Should means and funds be found for removing shoals, I consider the first and most immediate attention should be given in removing the Whiting shoal in Limehouse Reach, and the shoal in Woolwich Reach, called Ham Shelf.

I have seen the Report of Mr. Charles Rowland, embracing extended documents and extracts of papers and laws relative to the Port of London, which I have not thought necessary to wade through, as I consider the plans laid before your Committee embrace the most material point of the survey, and I think it more the duty of the City Solicitor to furnish the required information.

I beg leave leave most earnestly to call your Committee's attention particularly to the landing and embarking of passengers by steamers in different parts of the river, where piers are formed by barges; that practice appears to me most improper, as those barges ground the greater part of the tide, causing mud and other settlements to be deposited both above and below them. Whenever it is found necessary to make landings for the convenience of the public, open piles should be driven, that no obstructions to the tide should occur, which will, if resorted to, be the means of preventing the settlements complained of.

With respect to any regular plan for navigating the river, it must in a great measure be regulated by circumstances, and left entirely to the pilots and persons conducting vessels in the river.

The principal causes of accidents and damage occur from the great size of steam-vessels coming so high up the river, and navigating and towing against the tide, which occasionally come in contact with sailing vessels; but I can find no means to prevent this, as the interests of the upper docks require it.

I am, &c.,
JOHN FISHER,
Principal Harbour-master, Port of London.

To the Worshipful the Thames Navigation and Port of London Committee.

No. 283.

No. 283.

Page's Observations on the River and Port.

MR. PAGE'S *Observations on the River Thames and the Port of London, for the use of Her Majesty's Commissioners appointed to inquire into the State of Tidal Harbours.*

On entering on the important subject of the inquiry of Her Majesty's Commissioners on Tidal Harbours, with reference to the improvement of the Thames, it may be interesting and useful to refer to the state of the river and the proceedings respecting it in times past, subsequent however to the general embankment which confined its waters to their present channel, and which is ascribed to the energy and discipline which characterized the legions of imperial Rome.

No. 283.
Page's Observations on the River and Port.

Enclosure of the Marshes by the Embankments. Repair, &c., of the Banks under Commissions appointed by the Crown.

These embankments enclosed the marshes, but at a level much below that of the highest tides, and decreasing in height in proportion to their distance from the mouth of the river, as ascertained by Colonel Lloyd, an extract from whose levels is given in Note 1. The marshes at Woolwich are 11 feet 8 inches below the level of the highest tide.

The protection and repair of the embankments were under commissions appointed by the Crown, and reference to former surveys, and to the statutes of the realm, shows that the preservation of the banks was a subject to which great attention was devoted.

Commissions issued from 8 Edw. I. to 14 Edw. IV.

We find in Dugdale a list of 70 commissions issued from the 8 Edward I. to 14 Edward IV., having reference to the banks of the river between Oxford and Gravesend, the dates and objects of which are appended to this memorandum. (Note 2.)

Power of the Commissioners.

The Commissioners so appointed were authorized to compel the proprietors of the lands to pay the costs of the repairs of the banks, and in the case of the inning of marshes, to divide the land so gained among the parties contributing to the expense.

Banks of the River probably advanced by the Repairs

Although it does not appear that encroachments on the river were authorized, it is probable that in these repairs the banks of the river were gradually advanced, as during the repairs of the present wharfs several rows of piles have been found denoting the successive advances of the embankment. The old surveys of the river still existing, show, however, that in general a regular line was maintained.

The Statutes of Conservators of the Rivers relate to the Conservation of the Fish.

Mayor of London named Conservator of the Statutes on the Thames,

And in the Creeks and Breaches of the same.

The early statutes relate to the preservation of the fish, and to the appointment of conservators of those statutes; thus by the statute of 13 Richard II. (Note 3), after referring to the former statutes for the preservation of salmon, it was ordered "that the mayor or warden of London, for the time being, shall have the conservation of the statutes aforesaid, and shall make thereof due execution and like punishments as afore is ordained of the justices of the peace in the said water of Thames." And again (Note 4), in the reign of Henry VII., c. 14, 15, it was enacted that the said mayor shall have like conservation and rule in the breaches, issues, and creeks made in the river by means of floods, for the punishment of unlawful fishing, reserving, however, the waters in the king's land or land of private parties.

Regulations as to dredging for Ballast for Ships to be made by the next officer of State.

Subsequently it was enacted (27 Henry VIII.) (Note 5), "that the officers in charge of the ballasting of ships should remove the shelves between Greenwich and Richmond, and that upon any complaint, the Lord Chancellor, the Lord Treasurer, and others should at their discretion determine what shall be most convenient for the conservation of the said River of Thames, provided always that any person might take away sand, gravel, or earth from any of the shelves, without paying anything for the same.

Maintenance and Repair of the Banks, and proper dredging provided for.

This Act thus provided for the proper dredging of the river, and recited the provisions in former statutes for the maintenance of the banks and the preservation of the river from rubbish, &c., being thrown into it.

Effect of Breaches on the River creating Shoals, &c

One hundred and twenty acres of solid ground washed into the Thames by Dagenham Breach.

Size of the great channel in Dagenham Breach

The breaches made by the river in the banks, besides doing injury to the lands, brought great quantities of earth, &c., into the river, an instance of which is given in the Dagenham Breach, from which, as related by Captain Perry, 120 acres of solid marsh ground had been washed into the Thames; and from which he states the reaches upwards as well as those below had suffered, there having been found considerably less water in Woolwich Reach when the men-of-war had their moorings, and also that some banks had been thrown up since the breach below Gravesend. The breach itself had spread in 14 years into several large branches like the natural arms of a river, the longest of which was more than 1½ mile in extent; from 400 to 500 feet in width in places, and from 20 to 40 feet in depth. The operation of this breach and of others of a similar nature, though not so large, must have contributed largely to the formation of shoals.

Change in the management of the River.

The Act for the Appointment of Commissioners of Sewers having charge of the maintenance of the banks of the river (6 Henry VIII.), the grant to the corporation of the Trinity-house (36 Eliz.), to ballast the ships, and the commencement of a practice by the corporation of London to permit embankments led to a change in the management of the river.

Later proceedings not in accordance with the former Statutes, Acts of Conservancy, &c.

Partial Embankments.

The Forty-foot way.

The proceedings in later times have been almost altogether at variance with the previous directions from the Crown; the Acts of Parliament, and those of the Courts of Conservancy (Note 6), partial embankments at the houses of Parliament, at Whitehall, at Hungerford, at the Adelphi, at Somerset House, at Norfolk-street, at the Temple, and in various parts of the river down to Woolwich have been permitted, sometimes with the authority of Parliament, sometimes without, but scarcely, in any case, with consideration for the improvement of the river, or for providing any promenade or place of recreation for the public, excepting in the case of the forty-foot way between London Bridge and the Temple, which was provided for in the statute (19 Car. II., c. 3., and 22 Car. II., c. 2), in which also other powers for the improvement of the wharfs, &c., were given. (Note 7.)

Embankments above London Bridge referred to in Mr. Page's letter to the Earl of Lincoln, 1st July, 1843.

Plan of these Embankments.

It is not requisite in this place to enter further on the subject of the detached embankments, especially as I have referred to many of them on a former occasion in my evidence before Her Majesty's Commission for Metropolitan Improvements, and in a Letter to the Earl of Lincoln, the chairman of the Commission, in 1843, when the attention of the Commission was given to the embankment of the Thames. The embankments above London Bridge made subsequently to the reign of Charles II., were also laid down on a plan appended to that letter.

Practice of the Thames Navigation Committee.

The practice of the Thames Navigation Committee in permitting partial embankments on payment of fines and rents, and the formation of jetties, steam-boat piers, &c., for the accommodation of the public, is thus described by Mr. Walker:—

"One of the causes of the present great irregularity upon the shores of the river, even where embankments have been formed in modern times, has been the want of a general *system* or *plan* for guiding the lines of wharfs and embankments; so that each party has proceeded either without authority, or the Navigation Committee have granted or withheld the authority, and defined the line, as the applying or opposing party had the stronger argument or interest, without having more before them than limited information of the part of the river which was proposed to be embanked. Thus necessarily, although often with the best intentions, sanction may have been given to what was injurious, and resistance offered to what would have been beneficial, to say nothing of the effects of private interest and influence operating in the same injurious manner, where the Committee, of which all the members were not likely to be conversant with such matters, had no general guide before them, and where the duties of the conservator were therefore discharged with difficulty and uncertainty."

Circumstances leading to a line of Embankment being determined on.

These proceedings at last led to a defiance of the authority of the Committee, and in a Report to the Common Council, 20th January, 1842, they state that they "the Committee for improving the Navigation of the Thames, and for preventing encroachments in the said river, had received serious complaints of various projections in the river Thames, obstructing the navigation, and creating on the adjacent shores deposits of mud and silt; that these projections had been erected not only without the sanction of the Committee, but in some instances, in avowed defiance of their authority; that the City

Solicitor having met with some unexpected difficulties in proceeding against these nuisances, the Recorder, Common Serjeant, and other eminent Counsel had recommended that a line should be laid down beyond which all present and future encroachments upon the banks should be removed by whatever authority and under whatever circumstances made, and regardless to whom they might belong."

Line of Embankment laid down from survey in 1841. Differed from the line of 1840.

This line had been laid down by Mr. Walker, Capt. Bullock, R.N., and the City Officers, in 1841; and to this line all applications to the corporation for leave to embank must have reference. It differed from the line laid down by Messrs. Walker and Burges, brought before the Committee of the House of Commons in 1840, on the petition of the Corporation of London, and as it was intended to be carried out on the voluntary principle, it would have left the river line a line of projection and recess considerably more unequal than it is at present. This may be seen by reference to a plan showing the portions proposed to be embanked, and those proposed to be left in their present state.

Effects of acting on this proposed line.

It is not my intention to point out the merits or demerits of the line, even were it a line to be executed at one time and without reference to individual interests, but it is due to the Commission to show that, as the Corporation of London have subsequently granted licenses for embankments to this line, and as the parties applying for leave to embank must petition to carry out their wharfs to the line, these circumstances deter owners of property from repairing their wharfs or the river bank how much soever their interests may be suffering from the delay.

Twelve miles of the River frontage proposed to be Embanked by the City consists of wharf property, warehouses, &c.

Injury would be done by converting the water space into land.

Twelve miles of the river frontage where the embankment is proposed to be made, consists of wharf property of various description, with warehouses, cranes, &c., adapted to the respective business, and in many cases the space in front of the present wharf line is so valuable for *lie-byes* for barges, &c., that the conversion of this water space into a solid embankment would materially deteriorate the value of the property. In such cases the execution of the embankment, even without cost to the proprietors, would be a serious injury to them, and if its execution were left as intended to the voluntary acts of parties, no limit of time can be assigned for its completion.

The banks of the River require repair in various parts.

Ground washed into the river.

Encroachment of the River on the Isle of Dogs.

But although there are 12 miles of wharf property, which with few exceptions might with advantage to the river and to the proprietors be left in the present line, there are many miles of the river's bank which require immediate attention and repair, and especially below Greenwich; at various parts between Kew Bridge and Vauxhall Bridge, and between Greenwich and the entrance of the Thames, the banks have suffered materially from the action of the water, and great quantities of ground are annually carried away and deposited as shoals. The boundary posts between Greenwich and Woolwich at the river bank of Bugsby's Marshes were several feet within the grass line; now they are upon the shore, and from a recent survey made by me of the river line on the Isle of Dogs for the Commissioners of Her Majesty's Woods, &c., it is found that in places the river had encroached on the bank to the extent of 20 feet since the survey made in 1841.

Inquiries of this Commission.

Referring now to the inquiries of the Commission as to the present state of the river, the inconvenience to trade, &c., resulting therefrom, and the best remedy for such a state, it may be stated that the circumstances which are principally detrimental to the river are :—

1st. The shoals which interrupt the navigation, especially at low states of the tide.

2nd. The inefficient state of the river's banks, from which considerable quantities of earth are annually washed into the stream, and the practice of permitting partial projections, affecting the set of the tide, and producing deposits of mud, &c.

3rd. The discharge of the sewers within the limits of the metropolis into the river, containing, beside soluble matter, quantities of other material which deposits on the bed and shore, forming shoals and mud-banks.

4th. The absence of a proper system, and sufficient funds for the management of the dredging, the repair of the banks, and for that supervision and those improvements which are imperatively called for in a river of such importance as the Thames.

Of the Shoals.

Changes have taken place in the Shoals.

Irregular Dredging.

Clay not raised by the Ballast Lighters.

Serious obstructions presented by the Shoals to the flow of the Tide.

Shoals more prejudicial to the River than to the Navigation.

Reference to previous surveys shows that several changes have taken place in the shoals and shelves, and in the direction of the deep-water channel in various parts of the river; this might be anticipated from the breaches which I have before referred to, from the subsequent changes in its boundaries by embankments, &c., and above all, from the irregular mode in which the dredging is performed. Those parts of the bed of the river which consist of gravel fit for ballast being selected for this operation, while the other parts, consisting of clay, or even of hard material, if too expensive to raise, being avoided; and as the deepening in one part tends to produce a shoal in another, it may be regarded as a *question* whether the river would not in reality be benefited by the absence of dredging than by dredging so performed. Generally the injurious effects of shoals are spoken of as with referrence to the navigation of the river, but independently of the interruption to the navigation, they present serious obstructions to the free flow of the tide; on the flood, they diminish the velocity and volume of tidal water, and on the ebb, they prevent the continuous scour to which a river, with a regular channel is subject. In this latter respect they are more prejudicial to the river than to the navigation, as in one case they affect only certain classes of vessels at certain times; in the other their effect is constant. The irregularities in the width of the river are open to the public eye, they have their advantages and disadvantages; the irregularities in the depth are generally more important than the former, less apparent, and altogether disadvantageous.

Reference to the Shoals below London Bridge.

Operations on the Whiting Shoal.

The shoals below London Bridge have been especially referred to in the Reports to the Thames Navigation Committee, and laid down on Captain Bullock's chart of the river. The most prejudicial within my own observation is the Whiting Shoal in Limehouse Reach, on which spring tides ebbed to 4 feet, and which thus not only formed a barrier to the navigation of the river for larger ships during several hours of the tide, but caused considerable damage to vessels grounding on it; more than 50 sheets of copper torn from their keels and formed into rolls, by the vessels dragging on the shoal, having been found (I was informed by Captain Fisher) during the operation of removing part of the shoal.

Present dimensions of its Channel should be increased.

This operation of blowing up a stratum of conglomerate forming the shoal, and of dredging the substratum after this crust had been removed, continued during nine months, under the direction of Captain Fisher, and a channel has been opened through it, 100 feet in width by 13 to 16 feet in depth, and, although the depth may be expected to be maintained by the run of the tide through this narrow channel, it is to be hoped that means will be used to increase the breadth of the channel to 600 feet.

Importance of a deep-water Channel in this bend in the River.

It will be evident to the naval members of the Commission that a deep-water channel of considerable breadth is essential to the convenience, and even safety, of the navigation in this part of the river between Blackwall and Limehouse, to enable vessels to tack when changing their course so materially as they must do in a bend in the river, at right angles to its general course.

Page's Observations on the River and Port.

Great projection of the Shore in various places.
At Waterloo Bridge.
Scotland Yard.
Mud-bank at Whitehall Gardens.
River too shallow for the small Steamers.

Independently of actual shoals within the low-water channel of the river, there are numerous cases where the shore runs out so far from the wharfs as to cause great impediment to the navigation, and to produce irregularities in the set of the tide. This remark will apply to the river below London Bridge, but especially to it above, the shore at low water occupying four arches of Waterloo Bridge on the Surrey side, running 300 feet from the wharfs at Scotland Yard on the Middlesex side, and leaving in front of Whitehall Gardens a noxious and disgraceful mud-bank projecting 320 feet.

Besides these projecting shores at low water, there are shoals which render the navigation of the river intricate, if not dangerous, even for the small steamers which do not draw 4 feet of water; and in some places, at low water of spring tides, there is not a depth even of 4 feet in the transverse section of the river.

On the State of the Banks of the River.

Washing away of the Banks injurious to the River.

Effects of prohibiting Embankments for Repair, &c., to a given Line.

Partial Embankments stopped by the Crown, or by the usual legal process.

Evils of partial Embankments described by Capt. Bullock, R.N.

Without specifying localities, which (taken in the higher parts of the river, and below from Greenwich to Gravesend) would form a long list, it may be expected that the disrupted state of the banks tends materially to the injury of the navigation, and having ascertained that in parts the ground has been washed away to an extent of 20 feet in five years, some idea may be formed of the loss along the whole course of the river. In several instances, as I have before stated, the determination of the Navigation Committee to approve only a given line of embankment has operated to prevent the repair of these banks, while in others it has led to the commencement of partial embankments which have been stopped by the authority of the Crown, as the protector of the public rights, or removed by the usual legal process in such cases. It is not necessary to describe to the present Commission the evils of partial embankments and projections into the river—they have been particularly described by Captain Bullock, in his observations to the Thames Navigation Committee, and their injurious effects on the navigation, and in producing mud-banks, &c., noxious to the public health, are well known.

Besides the partial embankments before referred to, the river has been subject to encroachments on its tidal capacity by the formation of hards or ways, the shore being, in such cases, raised from 2 to 3 feet above the shore of the adjoining wharfs by which the tide is obstructed; deposits of mud are formed on each side of these raised hards, or increased expense is incurred by the neighbouring occupiers in clearing it away, the tendency being to induce them to raise their own shores in self-defence.

In cases where wharfs occupy a point in the river, the occupier is obliged to throw down material, chalk for instance, on the shore, to prevent his wharf being affected by the scour; and as the shore has thus to be renewed, the washing away of this material must shoal the river below.

The action of the steamers on the shore draws down the mud and gravel towards deep water; the run of the water from the shore to fill up the vacuum which the vessel tends to form astern lowers the water frequently a foot in depth, and, on a flat shore, leaves it dry as much as 70 feet in length, the water carrying with it the sand and smaller gravel. These are minor causes, but still, acting constantly, they tend to diminish the depth of water.

Of the Sewage.

Former prohibitions against discharging the Sewage into the Thames.

Causes of the change in the Sewage.

Number of Sewers discharging into the Thames.

Estimated quantity.

The discharge of the metropolitan sewage into the river, had by Acts of the Conservancy previously to the latter part of the last century been prohibited, and it was the duty of the Commissioners of Sewers to prevent the entrance of any noxious matter into the water-courses. The changes which subsequently took place in the internal arrangements of buildings, and a system of drainage suited to those changes, the covering over of the ancient brooks and watercourses of London, the River Fleet, the City Ditch, &c., induced the Commissioners of Sewers to allow the system of sewage which now prevails. Independently of the matter from the dwellings, part of which deposits on the shore of the river, a great quantity of sand, gravel, &c., is washed into the sewers from the streets, and as there are 118 sewers discharging into the river between Battersea Bridge and Greenwich, whose contents from careful experiments by Mr. G. Hawkins, under the direction of the Commissioners of Sewers for Westminster, have been estimated at more than 9¼ millions of cubic feet per day, descending from a surface of 58 square miles, it may be concluded without any attempt to approximate the quantity of solid matter deposited in the river from this source, that great injury must result from such a practice.

On the River as a channel for the Sewage.

On the general subject of the river as a channel for the sewage, I subjoin an extract from my letter to the Earl of Lincoln, before referred to, and I am sure that from the constitution of this Commission it is not requisite further to point out the importance of treating the Thames as a navigable river rather than as a great drain.

"In the Report alluded to the principal objects would appear to be the 'removal of shoals and mud.' To effect these objects, and to carry off the sewage more rapidly from the metropolis, the contraction of the river, not only in the locality under the notice of the Commission, but to a considerable extent beyond it, has been recommended. So important does this object of carrying off the sewage appear, that in referring to the first embankments of the Thames, it is stated by Mr. Walker that,[*] 'if the engineers at that distant period could have contemplated that on a length of only five miles there would be placed upon its banks a city containing two or three millions of human beings whose only drain would be the Thames, and that the citizens would invent and adopt luxuries in their houses which should discharge every kind of impurity into sewers and drains to be built in every street and alley, and which should all empty themselves into the river, more care would have been taken to equalize its channel, and so to contract the width at these densely-peopled portions so as to prevent the nuisances now justly complained of;' and that 'the want of further contraction in certain places is therefore not to be attributed to the ignorance of those engineers who constructed the embankments, but to the altered state of things since that time;'[†] 'that the Thames is the great drain of London and Westminster,' and that '[‡] the proposed embankment and contraction of the river will quicken the velocity and get rid of the vast banks of mud which pollute the river."

"Captain Bullock, also having stated [§] 'that the stream being made deeper and stronger by the embankment, would more effectually perform its cleansing office," finds an additional argument for the proposed measure in the circumstance '[||] that the Thames is rather wider above bridge than in the Pool,' and that 'this single fact, that the Pool is in general narrower than the river above bridge, is of itself sufficient to show that the latter is wider than necessary,' admitting, however, afterwards, that the Pool (which was to guide the contraction above) is, in fact, '[¶] *the narrowed part of the*

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[*] Report from the Thames Navigation Committee (1842), Appendix, p. 12.
[†] Ib.
[‡] Ib. p. 18.
[§] Ib. p. 27.
[||] Ib. p. 26.
[¶] Ib. p. 28.

river,' an opinion coinciding with that of Mr. Saunders, the water-bailiff, who very judiciously points out '* a greater width being required at the contracted parts at Globe Stairs and Old Swan Stairs," and observes that '† the reduction of the width of the river would diminish its capacity for the reception of tidal waters."

"As the object of these references and quotations is quite apart from any critical observation, and is only to show that the contraction proposed is chiefly for the purpose of 'removing shoals and mud, and carrying off the sewage more rapidly,' I will not extend them further, coinciding as I do in the opinion that the measure is well adapted for those particular objects. There is no doubt that if the river is to be treated as the great trunk of a system of sewage, the greater the fall of its bed the more contracted its channel (within certain limits), and *the less influenced it is by the tide*, the better is it fitted for the purpose, because the greater will be its velocity; its depth would be maintained by the *river water* acting in a contracted channel, and the exclusion of the tide would prevent the noxious sewage being floated back again above the points of its discharge. In this light, a line of continuous solid embankment, if executed as a whole, and if other circumstances did not intervene, would best answer the purpose.

"It remains now to be seen whether the treatment of the river proposed to improve it as a channel for carrying off the sewage can be successful in its results. It will be evident that the best trunk for sewage is that in which the direction of the stream is always toward the sea; in other words, that a river performing the office of a drain should not be a tidal river. Next to this, that a tidal river ‡ so used is the better adapted for it, in proportion as it has less tide to contend against; and that a river like the Thames at London and below it, with a flood tide carrying the sewage as high as Hammersmith, is of all others the least fitted for clearing the metropolis of the influence of the sewage; because, as many of the sewers are discharged towards low water, the flood tide carries up their contents in suspension as well as in mixture with its waters, and the ebb and flood alternately continue the sewage in a state of oscillation in the river between Hammersmith and Woolwich.

"From what has been before said of the operation of the river in approximating its state above London Bridge to that below, it may be seen that the changes taking place are such that the effect of the proposed contraction by a solid embankment, although it would be to exclude the tidal-water, and therefore render the river better adapted to carry off the sewage, would be counteracted by the increasing action of the tide.

"To show this more clearly, it will be requisite to refer again to Mr. Walker's Report to the Chairman of the Thames Navigation Committee, in which he states, § 'that at present (1841) the level of high water at London Bridge is *two feet higher* than at Sheerness,' quoting from Mr. Lloyd's levels, made in 1830, before the removal of Old London Bridge; the mark referred to by Mr. Lloyd, however, is the Trinity datum—the *then* high water of spring tides. But in the tables of Tidal Observations, which contain some information I was desirous of obtaining in order properly to understand the changes taking place, it will be seen that the level of high water at London Bridge above the high water at Sheerness, was, for the month of February this year, *more than three feet ten inches*, and for the months of March and April sometimes *four feet* and *even five feet* higher than at Sheerness. This circumstance of the increased rise of tide, and the advantages of it in a commercial point of view, I have before adverted to. In referring to the subject, Mr. Walker states that ‖ 'there are no sufficient grounds for supposing that the tides up the river now reach a much higher level than when the embankments were formed; but if they do, it must be caused by the tides at sea being higher than in ancient times." That their increased rise, however, cannot depend on this circumstance, will be satisfactorily proved by reference to the Tidal Observations for February this year; in which month, although the tides on several occasions were higher than in any month for a considerable time previously (and their overflowing was very detrimental to the inhabitants of the districts on the Surrey side of the Thames), yet during that month the mean level of the sea was actually four inches and three-tenths below the mean level taken as Mr. Lloyd's datum. And the rise of the tide at Sheerness, on the 18th February, producing a rise of 20 feet 10 inches above Trinity low-water mark at St. Katherine's Dock, was 11 inches below that on the 4th at Sheerness, which produced a rise of only 20 feet 7 inches at St. Katherine's. It is not requisite to adduce further examples (although they are numerous enough) to show that the reason suggested by Mr. Walker for the increased rise of the tide higher up the river, by supposing it to rise higher at sea, will not apply.¶

"But that it does rise higher is certain, and that it will continue to rise higher is no less certain, inasmuch, that as the river water and its own waters (even without the assistance that may be rendered by dredging, &c.) are gradually deepening the bed above London Bridge, gradually lowering the bank I have referred to, and thus *gradually removing the obstructions to the progress of its wave*, so it will attain both a greater height and a longer range.

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* Report from the Thames Navigation Committee (1842), Appendix, p. 32.

† Ib. p. 30.

‡ With reference to these observations, it must be noticed, that in a tidal river acting as a great trunk for drainage, the lower the low-water line the lower the drains can discharge, but at low water only; and that sufficient reservoirs are indispensable for the contents of the drainage while the tide is up. The embankments of rivers are always followed by this provision. The sewage is a momentous question in the present case, as affecting the supply of water to the metropolis.

§ Report from the Thames Navigation Committee (1842), Appendix, p. II.

‖ Same page.

¶ The circumstances operating on the rise of the tide in London, besides the first cause, are the following :—

1. The quantity of land water in the river, as in freshes or floods.
2. The direction and force of the prevailing winds.
3. The *difference of level between the surface of the water at the mouth of the river and in London*, when it is low water at the latter place, as shown in column 22 in the Tables for March and April,—a circumstance, I believe, not before ascertained. During a fog the *current* of the tide is extremely sluggish; this does not arise, however, from the *calm* attending a fog.

The following particulars relative to the extraordinary tide of 18th October, 1840, may be of some interest :—

The previous low water was at half-past eight A. M. at Sheerness, and at noon at the London Docks. At Sheerness the tide fell 9 feet 6 inches, and at the London Docks 10 feet 3¼ inches below the mean level of the sea, thus the level of the low-water line at the London Docks at noon was 9¼ inches below that at Sheerness at half-past eight A. M. At noon the tide had risen at Sheerness 11 feet, making the actual level of the surface of the water there above the surface at the London Docks 11 feet 9¼ inches. At this point of time, viz., at noon, the tide began its rise in the river, opposite the London Docks, and rose 21 feet 6 inches in three hours; at four it was high water, having risen 25 feet above its previous low water, and 14 feet 8¾ inches above the mean level of the sea.

At Sheerness it was high water at 2 h. 50 m. P. M., the tide having risen 21 feet, being 11 feet 10½ inches above the mean level of the sea.

The wind at Sheerness was from the west at low water, and blew the tide out; then changed to N.W. and by N., blowing a *full gale* (nearly a storm) until two o'clock, when it ceased. In London, to the best of my recollection, it was a calm. The tide overflowed all the low grounds, and several boats were in use in the streets in Rotherhithe.

This is a remarkable instance of the rise of the tide in London, depending, in some degree, on the difference of level of the surface of the Thames in London and at its mouth, at the previous low water.

"One of the consequences of this progressive change in the condition of the river is, *it will be less and less fitted as a channel for the sewage*, and that the tide will carry further and further upwards the noxious and filthy contents* which are daily poured into it, and to such an extent, that the sources from which the only two water companies who derive at present a supply of water from the Thames unmixed with the sewage, (viz. the West Middlesex at Barnes, and the Grand Junction at Brentford), will soon be contaminated in some degree like the others.†"

Of the Supervision and Improvement of the River.

Under this head I would bring under the notice of the Commission the evils attending the crowded state of the Pool.

The regulations for the mooring of vessels in the river would appear to depend on the wants of the coal trade, and on the means now in use for unshipping the coals. Thus the tiers of colliers occupy the space between the Wapping entrance of the London Docks and the Regent's Canal, the object being to keep the collier tiers as high up as possible, that the coal-barges may reach the wharfs in the upper part of the river in one tide.

These barges, as some members of the Commission are aware, leave the tiers with the first of the flood, and frequently occupy, in parts, the entire width of the navigable channel; subject to no controul or regulation, they are turned broadside to the tide, if it so please the lighterman, and thus three of them so disposed are sufficient to block up completely the navigable channel between the Hermitage entrance of the London Docks and Nicholson's Wharf; not only is the passage on the river frequently stopped by these circumstances, but great damage has been done to vessels, and with a sluggish neap-tide and westerly wind, the craft occupy considerable time in reaching London Bridge.

The large steamers coming up the river, and impeded in their progress by the craft, are frequently thrown athwart the tide, and great delay occurs before they can be righted.

By the present regulation the number of ships in each tier, and the time for each ship to remain in the tier, is limited, and any encroachment on the navigable channel from these tiers depends upon the additional space they occupy when boomed off to admit the barges, or when swung out as far as their moorings will allow by the wind in certain directions.

It must be evident, however, that in a channel as allowed by the bye-laws, 300 feet in width from low-water mark to the outermost ship, of which not two-thirds may have sufficient depth of water for a vessel, and which channel is not in the set of the tide, a slight encroachment may produce disorder; and when it is considered that this channel must accommodate the large ships entering the Docks (towed at times by two tugs, one on each side) all the steam ships coming above Blackwall, the coasters and the passage steamers, which in summer are running through the Pool every five minutes, it must be concluded that every precaution should be adopted for maintaining the channel free from any avoidable interruption.

From the Wapping entrance of the London Docks to London Bridge, the Pool is occupied by various trading vessels, coasters, and steam ships, not subject to the limitation as to the time each vessel may remain in tier, like the colliers, but subject nominally to the width required by the bye-laws for the navigable channel, which, from Iron Gate Stairs, near the Tower, to London Bridge, is stated at 200 feet, but which is generally considerably less; and it is in this part of the Pool that a stoppage generally occurs.

Having now referred to the management of the river in times past, and pointed out the imperfections in this and in the course pursued in its treatment, I would submit to Her Majesty's Commissioners the following suggestions for the improvement of the river in its navigable character, with the least interference with private interests, and I may add, with the least expenditure; the suggestions are—

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* The number of sewers discharging into the Thames on the Middlesex side of the river, between Vauxhall and London Bridges, taken in March, 1841, is given in the Appendix. There are also three large sewers, the Ranelagh Sewer, the Effra Sewer, and King's Scholars' Pond Sewer, which discharge their contents above Vauxhall Bridge, in the immediate neighbourhood of the suction pipes of the Chelsea, Southwark, and Vauxhall Waterworks.

† The legislative enactments of Parliament, and the regulations of the Courts of Conservancy of the City of London, appear to have been especially directed to the maintenance of the purity of the Thames water, by preventing the discharge of any sewage into it, as the following extracts will show:—

In 16 Richard II., A. D. 1390, it was enacted, "that all filth upon the side of the Thames, next the house of Robert de Partis, shall be utterly removed;" and "that no person do throw, or cause to be thrown or laid, any filth or ordure, muck, rubbish, or laystage, in the same water of Thames, of the one side or the other, between the Palace of Westminster and the Tower of London, on loss of 10*l.*"

By an Act of Common Council of the City of London, made in pursuance of the statute 27 Henry VIII., A. D. 1538, for the preservation of the River of Thames, it was ordered, for preventing rubbish entering the river, "That strong grates of iron along the said water-side, ond also by the street-side, where any watercourse is had into the said Thames, be made by the inhabitants of every ward, so along the said water as of old times has been accustomed; and that every grate be in height 24 inches at the least, as the place shall need; and in breadth, one from another, one inch."

And "if any person or persons, in great rains or other times, sweep their soilage or filth off their houses into the channel, and the same afterwards is conveyed into the Thames, every person so offending shall forfeit for every default 1s 8*d.*"

In the year 1584, in the mayoralty of Sir Thomas Pullington, and in 1630, in the mayoralty of Sir Robert Ducie, it was ordered, 1st. "That there should be no perpresture, encroachments, wharfs, banks, walls, or buildinge of houses in or upon the Thames, to the stopping of the passage."

Item. "That no dung, rubbish, or other filth be cast into the Thames."

Item. "That no posts or stakes be fixed in the Thames."

Item. "That the fair-way be kept as deep and large as heretofore it hath been."

Again at Guildhall, 13 May, 1698. Humphry Edwin, Lord Mayor, it was prohibited for "any manner of person or persons to cast or lay any dung, ordure, rubbish, sea-coal, dust, rushes, or anything noyant in the river *Thames*, *Walbrook*, *Fleet*, or other ditches of this City."

The foregoing extracts show the attention paid by the conservators of the river to the purity of its waters and to the depth and width of its channel, and that the water-courses leading into it, and the dykes or ditches were not allowed to be receptacles for what is now called the sewage.

The Commissions of Sewers issued by 6 Henry VI., "to all parts of the realm where need shall be," also, in the 8, 18, and 23 Henry VI.; 12 Edward IV.; 4 Henry VII.; 6 Henry VIII., were more particularly ordained; 23 Henry VIII., for the preservation of the marshes and lowlands from inundations of the sea, or overflowinge of rivers, and for "repairing and amending the walls, ditches, banks, gutters, sewers, gates, calcies, bridges, streams, and other the premises in all places needful;" and to cleanse and purge the trenches, sewers and ditches in all places necessary. And by the 3rd James I., it was enacted, that "All walls, ditches, banks, gutters, sewers, gates, causeys, bridges, streams, and water-courses, within two miles of London, having their fall into the Thames, shall be subject to the Commission of Sewers."

The arrangements for the cleanliness of the sewers appear to have been as stringent under the Commissioners as the enactments above referred to, for the evidence* before the Select Committee of the House of Commons (March 1834), on the Sewers of the Metropolis, showed that until the beginning of the present century the soil from private dwellings was not permitted to be drained into the sewers, that persons were fined for neglecting this prohibition, and that the change was made by the Commissioners "when the sewers were so improved as to be able to carry off the soil."

* See the evidence of Mr. Houseman, clerk to the Commission for Westminster.

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Suggestion for a capacious navigable channel at low water.

That the shoals should be removed by dredging, under proper management, and the whole bed of the river in that part to which the inquiries by the Commission are directed, should be brought to an *uniformly increasing depth;* that where practicable without injury to the wharfs, &c., a channel, 600 feet in width, with an average depth of 14 feet at low water, should be obtained, and that the shores should be reduced to a regular inclination from the foot of the wharfs to the edge of this channel, the inclination depending on the distance from the wharf line to low-water mark.

And for additional space for the ships instead of embanking those spaces.

That in those parts of the river between Blackwall and Limehouse, where the width is considerable, an additional width should be dredged out for tiers of colliers or other ships, which could be moved up into the upper Pool in turn, and thus the number of vessels in the Pool itself would be reduced, and an ample water-way maintained.

On this part of the subject I would observe, that the great object of a conservancy ought to be the maintenance or improvement of the width and depth of the river, and that with judicious and not expensive management, the best means of improving the depth is to increase the capacity of the river for tidal water (Note 8), especially in those parts where the tidal reservoir is most important, and which can be ascertained by experiments similar to those in the Appendix to the letter I have before referred to. A low-water channel of sufficient capacity being once obtained, all the water that can be brought into it should be secured, and instead therefore of filling any portion of the navigable division of the river by embankments, it is desirable that side spaces should be left open both as a reservoir for the tidal water and as lie-bye for ships; it is also important to observe that any encroachments on the width of the Pool *would produce increased damage to the shipping* in those winters when the floating ice and force of the tide have driven whole tiers from their moorings, and piled the barges one upon the other, of which I have been an eye-witness.

Importance of maintaining the width and increasing the depth of the Pool.

Both on the principles of conservancy and for commercial purposes, I would strongly urge upon the Commissioners the importance of maintaining the width and increasing the depth of this part of the river. Embankments can be made at any time under judicious regulations, and with a conservancy properly constituted, and (should this part of the river not be required by the increasing commerce of the port of London, which I anticipate it will) such embankments might be allowed as would regulate its present high-water line, and not diminish its capacity. One of the reasons assigned for a continuous embankment is the necessity of new frontage with sufficient foundations to allow the mid channel of the river to be dredged deep enough for the purposes of trade; but the Commissioners, by reference to Captain Bullock's valuable chart of the river, will be satisfied that in very few cases, *if in any*, with the width of the river as at present, will that precaution be requisite; for from the Custom House to Blackwall the 600 feet of low-water channel proposed would allow from 220 feet to 560 feet from the low-water mark to the wharf line on one side or the other, and therefore there need be no apprehension for the wharfs in forming the channel now recommended.

A continuous embankment of the River not requisite to obtain a good channel.

Repairs of the banks to be strictly enforced.

The repair and maintenance of the banks of the river in every part where encroached on or washed away should be strictly enforced, without compelling the proprietors to make projections to the line recommended by the Corporation of London, a condition which, as I before stated, prevents necessary and judicious repairs, and in embankments above bridge, the capacity of the river for tidal water should be maintained, more especially in those ports whence the tidal water running out on the ebb operates most efficiently in the scour of the Pool.

Remarks on the position of the tiers.

Having ventured to suggest to the Commission the attainment and maintenance of a regular navigable channel at low water—the regulation of the shores—the maintenance of the banks of the river—and the protection of its capacity for the waters of the tide, I would draw their attention to some observations on the position of the tiers in the Pool. It would appear to be conceded that the best navigable channel is that which lies in the direction of the set of tide, and that in this direction the river should be kept free from obstructions; but for some reasons (which are contained in the Appendix to the Report on the Port of London, 12th August, 1836), several of the tiers of colliers are moored in the set of the tide, and it is alleged that there would not be depth of water maintained if they were moored out of it. It must be evident, however, and I have contended the point with the harbour-masters, that the scour which takes place under the tiers must cause shoals above and below them, and this I ascertained by soundings; and although it is true, as they state, that the ballast-dredgers take these shoals away, yet as any obstruction to the tide in the main channel should be removed, both on this account and for the benefit of the navigation, the tiers should be so disposed that a *free waterway in the direction of the tide may be secured.* This being effected, the ships in the collier tiers should be reduced in number and disposed in the dredged channel, lower down the Pool; and by the use of steam tugs the coal barges may be towed up in sections to London Bridge, coming up with the first of the flood, so that the Pool would be clear of them before the arrival of the merchant ships. Steam is used for whole fleets of mackerel-boats as well as for ships of burthen, and it is surprising that the nuisance of the coal-barges in the Pool should have been so long permitted in an age which is rife with mechanical arrangements for expediting the movements of the public, and in a place where a number of towing steamers is always available.

Steam-tugs recommended to tow the barges.

Of the constitution of a conservancy for the Thames.

Regarding the constitution of a conservancy, it may be assumed that the interests of the parties connected with the river unite in the improvement of the commerce of the Port of London. The Admiralty—the Board of Works, &c.—the Corporations of London and the Trinity House—the Dock Companies, and Steam Ship Companies, are all interested, therefore, in improving the condition of the Thames, but none are at present properly represented. I speak with submission to other opinions in suggesting that the two departments of Government claiming the water and the land—the Corporation of London and the Trinity House and the shipping interest—should have delegates in such a Commission of Conservancy, and that the Government should have the controlling power (in case of difference of opinion), acting on professional advice, based on sound principles; and especially that all income derivable from the river should be available for carrying into effect the operations determined on, the most of which, it may be said, has prevented the Corporation of London from effecting improvements in the channel.

The River Thames, under a Conservancy so constituted, might be brought into a condition befitting its importance as a navigable river and the extent of commerce on its waters—and would contribute, by the proper appropriation of its shores, to the ornament and improvement of a metropolis of which it has been the origin and support; but to effect these changes there must be added to a knowledge of the best measures, an energy and determination to carry them into effect.

THOMAS PAGE.

APPENDIX B.

LONDON.
River Thames.

No. 283.
Page's Observations on the River and Port.

MEMORANDA.

NOTE 1.

"The Yantlet Creek marshes are about 6 inches higher than the Sheerness marshes.

"The Allhallows marshes, in a distance of three miles, are 2 feet 1½ inch higher than the Yantlet Creek, and 2 feet 7½ inches higher than the Sheerness marshes.

"The St. Mary's marshes are 1¾ inch lower than the Yantlet Creek marshes, and 2 feet 3 inches below the Allhallows marshes, having fallen that quantity in a distance of three miles.

"The Higham marshes are lower than those of Yantlet Creek by 9¼ inches, than those of Allhallows by 2 feet 11 inches, and than those of St. Mary's by 7¾ inches, having fallen the last quantity in five miles.

"The marshes between Northfleet and Greenhithe are lower than Yantlet Creek, 1 foot 7¾ inches; than Allhallows, 3 feet 9 inches; than St. Mary's, 1 foot 6 inches; than Higham, 10 inches; being a fall of this last quantity in six miles and a half.

"On the eastern side of Dartford Creek the marshes are 3 feet 1 inch below those of Yantlet Creek, 5 feet 1 inch of Allhallows, 2 feet 10 inches of St. Mary's, 2 feet 3 inches of Higham, and 1 foot 4 inches below the marshes between Northfleet and Gravesend; being a fall of the last quantity in four miles and a half.

"The marshes near Woolwich Arsenal, to the eastward of the practising ground, are 4 feet 3 inches below those of Yantlet Creek, 6 feet 5 inches of Allhallows, 4 feet 2 inches of St. Mary's, 3 feet 6 inches of Higham, 2 feet 8 inches of the marshes between Northfleet and Gravesend, and 1 foot 3 inches below the Eastern Dartford Creek marshes; being a fall of 1 foot 3 inches in six miles.

"The marshes of Greenwich, as far as the few observations I had the opportunity of making, are 6 inches higher than those of Woolwich; therefore less that sum than the comparison of the Woolwich marshes."

NOTE 2.

Kent.

E. II. First mention made of Commissioners being constituted is in 8th Edw. II., two appointed, by Kings Letters Patent, dated 10th April, at Wyndsore, to repair banks and ditches, &c. &c., for safeguard of those lying betwixt Dertford Flete and Grenewich.

9 E. II. Others had like Commission for the same marshes.

13 E. II. Others appointed to view broken banks betwixt Grenewich and London Bridge.

In the 15th Edw. II., others had like assignations, to view and repair a certain breach newly made betwixt Grenewiche and Wolwiche by the violence of the tides, and in the next year others were appointed for repair of those about Grenewiche, and parts adjacent.

17 E. II. Another breach happening betwixt Grenewiche and Wolwiche, Commissioners were appointed to view same, and to destrain all persons through whose default it happened, to make good same; and also others who might have safeguard from the making of these banks, to contribute thereto. Within two years after another breach occurring above Grenewich towards

19 E. II. Bermondseye, Commissioners were appointed to view and repair same, and to destrain all persons who ought to have maintained said banks; and if they were unable to do the repairs in sufficient time, all others having lands guarded by said banks to contribute their share according to the proportion of their land.

27 E. III. Commissioners appointed to view and make enquiry touching certain breaches in the banks and marshes of Dertford, Erde, and Stone, and of the sewers and gutters there; the corn sown in these marshes, also the meadows and pasture grounds became drowned by the tides, and to use speedy remedy for the same. In the same year other Commissioners were appointed to view banks betwixt Greenwich and Plumstede, and repair same, whose Commission bears date the 7th of May; and on the 25th of the same month (such was the necessity) another Commission was issued to impress labourers, at competent wages, for the repair of said banks betwixt Greenwich and Plumstede, unless employed on the King's own work, nor retained in the service of others.

28 E. III. Others appointed to view banks in the marshes of Stone, then ruinous from violence of the sea, through neglect of landholders therein.

31 E. III.
34 E. III. Others appointed concerning the banks betwixt Greenwiche and Dertford, and others for a certain breach of a bank near Stone, whereby the marsh of Stone and adjacent parts were overflowed and drowned.

38 E. III. Others appointed to repair banks betwixt Greenwiche and Plumstede.

41 E. III. Others for the marshes of Dertford and Eard.

42 E. III. Others for the banks betwixt Wolwiche and Eareth.

47 E. III. Others for the marshes betwixt Plumstede Marsh and the marsh of Lesnes. Others for repair of divers banks on the Thames.

48 E. III.
1 R. II. Others appointed of Dertford and Stone, and likewise for banks betwixt Hicham and Dertford.

2 R. II. Commissioners appointed to view and repair of banks betwixt Dertford and Grenewiche; and the next year, for those
3 R. II. banks betwixt Combe and West Grenewiche.

16 R. II. For the banks betwixt Grenewiche and London Bridge.

17 R. II. Commissioners appointed for repair banks and ditches, &c., betwixt Plumstede and Northflete, according to the custom of Romeneyo Marsh.

20 R. II. Others appointed for repair of banks at East Grenewiche; also for those betwixt Depford and Charleton.

22 R. II. Others for banks in the marshes of Dertford and Stone.

1 H. IV. Others appointed for repair of all banks betwixt Wollewiche and Suthwarke, and to impress labourers, at competent wages, and to act according to marsh custom, and the law of the realm.

3 H. IV. Commissioners appointed to view, and caused to be repaired, the marshes of Est. Grenewiche, Combe, Charleton, and Wollewyche. And in the same year, others for the marshes of Derteford and Stone.

5 H. IV. Others appointed for Derteford marsh, to proceed according to marsh custom.

6 H. IV. Others had like appointment for those betwixt London Bridge and Grenewiche.

13 H. IV. Others had like appointment for those betwixt West Grenewyche and S. Margaret's atte Clyve, and to proceed according to custom.

12 H. IV. Others constituted for the banke betwixt Grenewyche and Depford, according to the marsh law.

Commissioners appointed for repair of banks betwixt Northflete and Grenewyche, according to the law of custom of England.

15 H. IV. Others appointed for those banks in the marshes of Dertford and Stone, and in Swaines compe, with power to impress labourers, on account of the great necessity in respect of damage impending.

14 E. IV. Others appointed for viewing and repairing the banks from West Grenewich to Gravesend, and to proceed according to the law and custom of this realm, and custom of Romeney Marsh.

In the same year the like Commission for those banks betwixt Wolwiche and Northflete; and to act therein as aforesaid.

Essex.

8 E. I. Upon complaint made to the King in the 8th Edw. I., by the Abbot of Stratford, that he was yearly in the habit of repairing the banks and ditches of the marshes of West-hamme when they required it, for preservation of his and his neighbours' lands lying within those marshes, against the overflowings of the Thames and Luye, and his neighbours did neglect to repair theirs, the said King directed his precept to the Shireeve of Essex to distrain all those found faulty therein, that the Abbot might have contribution in that behalf.

15 E. I. Commissioners were appointed to view and repair the banks and ditches in this county, on the side of the Thames and parts adjacent, then in decay, and to inquire through whose default they became so ruinous.

20 E. I. The Abbot of Stratford made a new complaint to the King, whereupon the King required the Sheriff to distrain all who ought to repair their banks and ditches, and had not done so, and all others who refused to contribute, according to their proportions.

E. I.
4 E. I. Commissioners were appointed to view and repair banks and ditches in this county, and those at Wolwyche, in Kent.

to 9 E. II. The like commission was assigned to others for those in Essex only.

17 E. II. Several others were appointed in the reign of 3 Edw. I. to 9 Edw. II.

Others appointed for all marshes on the Thames in this county, and others for the banks betwixt Stretford atte Bough and Est Tilbury, and parts adjacent.

18 E. II. Others appointed to view and repair the banks of the marshes of Esthamme, in Essex, and Woolwiche, in Kent.

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Surrey.

The first Commission appointed, directed to John de Metingham and Will. de Carleton, for the view and repair of the banks, &c., betwixt Lambebeth and Grenewiche. 23 E. I.

About three years after this, through neglect of those who ought to have maintained the banks near Retherhithe, the breaches whereof were such that great part of the marshes became drowned, the King appointed Will. Haward (soon after one of the justices of his Court of Common Pleas), to whom he assigned a certain sum of money for the work, the said William added thereto of his own purse; the King, by advice of his council, ordained, that all those lands which through neglect were thus overflown, should be seized into his own hands, and be committed to some trusty person willing to take charge of the repairs, and to hold the same until he should reimburse himself out of the profits of said lands, to whatever he may lay out on the work. 31 E. I.

John de Foxle, Walter de Gloucestre, with others, were assigned to view a certain breach of a bank near Bermundsey, and to provide for repair thereof. In the same year, the said breach, the Prior and Convent of Bermondsey received great loss by the drowning of certain grounds belonging to that house, the King, at the request of Isabel, his Queen, granted that nothing belonging to the said priory should be taken to the use of the King, or any other, without the assent of said prior and convent. 3 E. II.

The like breach happening in the banks of the marshes in Suthwarke, which did belong to the Knights Templars, but then in the King's hands, he directed his precept, dated at Barwick on Tweede, 23° Maii, 4 Edw. II., to William de Montalt (at that time guardian of those lands), commanding him, out of the profits, to speedily repair them. 4 E. II.

In the 9th Edw. II., Richard de Repham and Edmund de Passele were appointed Commissioners for the view and repair of banks, &c., betwixt London Bridge and the manor called Fauxes Halle, as also a bank in the land of the Bishop of Winchester, in Suthwarke, was then broken; and to distrain all such persons, in respect of any lands they held, were obliged thereto, for repair of bank and ditches. 9 E. II.

An inquisition taken before John de Everdon and Geffrey de Hentelpole, King's justices, to inquire into defects of banks betwixt London Bridge and Grenewiche, part of a bank, 13 perches, broken at Retherhithe, Sir John Latimer, Kt., had been charged with repair, time out of mind, in respect of certain messuage he held. 13 E. II.

In 26 Edw. III., Commissioners appointed to view and repair banks at the Stewes, and in places adjacent, by the breach whereof divers grounds and meadows lay drowned. 26 Edw. III.

Other Commissioners appointed for those banks near said Stewes, opposite the manor house of John de Moubray. Presentments were made before said Commissioners, touching those banks and sewers near the same Stewes, many persons found faulty paid fines to the King; others claimed they had made good what belonged to them. 37 E. III.

Other Commissioners for the banks from Danielisswalle, in Surrey, to Rodulisbourne, in Kent. 42 E. III.

Others appointed for same banks betwixt Danyeleswalle and the land of the Prior of S. Mary de Ouvere and a meadow called Crouchemede, to proceed according to the law of the realm. 48 E. III.

Commissioners appointed to view the banks of the Thames, on both sides, from Reading to Oxford, then broken in many places, and to repair same, according to the law and custom of England. 4 H. V.

Others appointed for the banks betwixt Depford Strond and Bermundsey, to proceed according to marsh custom and law of the realm. 5 H. V.

Several other Commissioners appointed for all those banks within the lordships of South Lambehithe, North Lambehithe, Lambehithe Mershe and Parysh-garden, as in Southwerk, Bermundsey, Retherhithe, Depford Stronde, Peckham, Hacham, Camberwell, Stokwell, Clapham, and Newyngton, in the counties of Surrey and Kent, then broken and in decay; and to repair same, according to the law and custom of Romeney Marsh; and to impress diggers and labourers with speedy dispatch. 22 H. VI. 23 H. VI.

Commissioners appointed for the view of banks from East Grenewiche, in Kent, to Wandesworth, in Surrey; and others for those betwixt West Grenewiche and Wandesworth aforesaid. 31 H. VI.

Others appointed to carry out said repairs. 5 E. IV. to 14 E. IV.

Middlesex.

First mention made of Commissioners being appointed is in the 26th Edw. I. Robert de Retford and Henry Spigurnell were appointed to view and repair banks and ditches in Stebbenhethe and parts adjacent. 26 E. I.

In 18 Edw. II., an inquisition was taken at the Hospital of St. Katherine's, near the Tower of London, before two of the King's Justices, for view of banks, ditches, &c., betwixt said hospital and the town of Chadewell, for repair of same, jurors made oath, the lord of the manor of Stebenhethe, name they knew not, did by his industry recover about 100 acres, which marsh was then drowned by the overflowing of the Thames. 18 E. II.

A certain bishop then holding the said lands should have repaired the banks, the bishop and his bondmen refused to repair. The bishop pleading a mighty flood happened, proceeding from the tempestuousness of the sea, which overflowed all the banks, as well those of other men as of the bishop and his bondmen, which flood broke down the banks, and could not be repaired by one tenant, and that all having their land overflowed ought to be charged; and if all would agree, the bishop and his bondmen would be ready with their share. The jurors decided the bishop had not neglected, and the sheriff was ordered to destrain not only the bishop and his bondmen, but all others having lands betwixt said hospital and the town of Shadwell, within the before-specified peril, for repair of said breach made by the great flood.

Commissioners appointed to view and repair said banks betwixt the said hospital of St. Katherine and Shadwell. 18 Ed. II.

Commissioners appointed to view and repair banks within the precincts of Westminster and parts adjacent, betwixt a place called Neyt and Temple Bar, then broken and in decay by force of tide. 18 Ed. III.

Others appointed for those in the town of Stebenhethe before mentioned, as also upon the river of Lye, in the confines of Middlesex and Essex, in a certain part of Hakney, near a mill called Trachehegge, betwixt said town of Hackney and the town of Welcomstowe, in Essex. 28 Ed. III.

Others were assigned for all banks betwixt the chapel of St. Katherine in Middlesex and Est-Tilbury in Essex. 36 Ed. III.

In the next year others appointed for those banks, in the marshes of Stebenhithe, Bramelege, and Redclyve, and elsewhere, within the lordship of the Bishop of London, on the verge of the Thames. 37 Ed. III.

And in 38 Edw. III., others for those of Stebenhithe and Brambeley, from the Tower of London to the river Leye. 38 Ed. III.

Commissioners appointed for the banks betwixt the mill of St. Katherine, near the Tower of London, to the chapel of St. Marie Matfelon, thence to the church of St. Dunstan in Stepenhithe, thence to the church of St. Leonard in Bremley, thence to the river Leye, thence to the Thames, and thence to the said mill. And to make laws according to the custom of Romeney Marsh. 26 H. VI.

A breach made in the bank belonging to John Harpour, opposite Depford Strond, of 20 rods, to the land of John Fyloll, a 1000 acres of land in asid marsh drowned, and that he, the said John, was obliged, in respect of their land, to take care of its amendment. 27 H. VI.

Commissioners appointed to repair all banks betwixt the Tower of London and the town of Stratford atte Bowe. According to the laws and customs of Romeney Marsh. 14 E. IV.

Others appointed for those banks betwixt Lymeostery and the wall, called Blackwall. In the same year others had like appointment, for all banks on the Thames and Leye, betwixt the bounds of the city and bridge at Stratford atte Bowe. 20 E. IV.

Others appointed for repair of banks, betwixt the before-mentioned chapel of St. Katherine and Berkynflete, in Essex. 41 E. III.

Others had like commission, for all those on the coast of the river of Leye, as of Thames, in the parish of Stebenhithe. In the same year two others for the same parish, upon the river Thames, with powers to take labourers. 43 E. III

Others had like Commission for those betwixt Blackewall and the before-mentioned hospital of St. Katherine. In 4 Rich. II., others for those upon the river Lye, betwixt Stebenhythe and Bramle. 1 R. II.

Others appointed for those betwixt the town of Stratford atte Bowe and the Tower of London. 19 R. II.

Commissioners appointed for the banks in the marshes of Stebenhithe and Walmershe, and to make laws for defence thereof, and to impress labourers at competent wages, in respect of the breaches in those banks. 6 H. VI.

NOTE 3.

Extract from Rich. II., c. 7-9.

The Statutes 13 Ed. I., s. 1, c. 47; 13 Ric. II., s. 1, c. 19, for the preservation of Salmons, &c., recited.

Item. Where it is contained in the statute of Westminster the Second, that young salmons shall not be taken nor destroyed by nets, or by other engines, at the stanks of mills, from the midst of April till the Nativity of St. John the Baptist, upon a certain pain limited in the same statute. And whereas by a statute made the thirteenth year of the King that now is, it was ordained, that the said statute of Westminster the Second should be firmly holden and kept, joyning to the same, that young salmons should not be taken at the (mills, stanks) or elsewhere, upon the same pain, and that no fisher nor gartluman, nor none other, of what estate or condition that he were, should not put from (henceforth) in the waters of Thamise, Humber, Ouse, The Justices of Peace shall be Conservators of the recited Statutes.

Under Conservators appointed by the Justices.

The Justices shall inquire of Offences at the Sessions

The Mayor of London shall have the Conservancy of the Statutes in the Waters of the Thames.

Trent, nor none other water of the realm, by the said time, nor by none other time of the year, any nets called Stalkers, nor other nets or engines whatsoever (may) in anywise be taken or destroyed, upon the pain aforesaid. And also it was rehearsed in the said statute, made the said thirteenth year, that where it is contained in the same statute of Westminster, that all the waters in which salmons be taken in the realm shall be put in defence, as to the taking of salmons, from the day of Nativity of our Lady till St. Martin's Day, it was ordained and assented in the same statute made in the said thirteenth year, that the waters of Lone, Wyre, Mersee, Ryblyl, and all other waters in the county of Lancaster, should be put in defence, as to the taking of salmons, from the day of St. Michael till the day of the Purifaction of Our Lady, and in none other time of the year, because that salmons be seasonable in the said waters by the time aforesaid; and that in the parts where such rivers be, good and sufficient conservators of the said statute, made the said thirteenth year, should be assigned and sworn, as it was ordained in the statute of Westminster, and that they should punish the offenders upon the pain contained in the same statute of Westminster, without showing any favour thereof; which statutes have not been hitherto duly executed for default of good conservators, as our said lord the King hath perceived by complaint to him made in this present Parliament. Wherefore it is accorded and assented, that the justices of the peace of all the counties of England shall be conservators of the said statutes in the counties where they be justices; and that they, and every of them, at all times when they may attend, shall survey the offences and defaults attempted against the statutes aforesaid; and also shall survey and search all the wears in such rivers, that they shall not be (very) strait for the destruction of such fry and brood, but of reasonable wideness after the Old Assise (used or accustomed), and that the same justices, or any of them, which shall find default or abuse against the statutes aforesaid, shall make the punishment of them which be found in default after the content of the same (statute); and that the same justice shall put good and sufficient under-conservators of the same statutes under them, which shall be sworn to make like surveying, search and punishment, without any favour thereof to be showed; and moreover, that the same justices, in their sessions, shall inquire as well by their office as at their information of the under-conservators aforesaid, of all trespasses, misprisions, and defaults, made against any of the points aforesaid, and shall cause them which be thereof indicted to come before them, and if they be thereof convict, they shall have imprisonment, and make fine after the discretion of the same justices; and if the same be at the information of any of the under-conservators aforesaid, the same under-conservator shall have the half of the same fine. And forasmuch as it is granted to the citizens of London, by the King's progenitors, that they may remove and take away all the wears in the waters of Thames and Medeway, and that they shall have the punishments thereof pertaining to the King; our said Lord the King, in this present Parliament, by the assent aforesaid, hath granted, that the mayor, or warden of London for the time being, shall have the conservation of the statutes aforesaid, and shall make thereof due execution, and like punishment, as afore is ordained of the justices of the peace, in the said water of Thames, from the bridge of Stanes to London, and from thence (over) in the same water, and in the said water of Medeway, as far as it is granted to the said citizens, as afore is said.

Note 4.

Extract from 4th Hen. VII., c. 14, 15.

An Act that the Mayor of London shall have the rule of the Ryver of Thames from Stanes to Yendale.

Jurisdiction of the Mayor of London over the River Thames.

Breaches, Issues, and Creeks made in the River by means of Floods.

The said Mayor shall have take Conservation and Rule in such cases, as for the punishment of unlawful Fishing.

Prayen your Highnes the Comons in this p'sent Parliament assembled, that wheire the Maire of your Citie of London for the tyme being is conservator havying the conservacie of the watir and ryver of Thamys, from the brigge of Stanes unto the waters of Yenedale and Medeway, It is so that within fewe years by tempest of wedir and great abundance of watir in the said ryver of Thamys, div's breches, issues, and crekys hath ben and growen out of the said ryver of Thamys, and by the same div's pastures, and medues and groundes of div's p'sones hen drowned and overflouen in whiche breches, issues, and crekes and groundes drowned the frye and brode of fisshe for the moste partie restith; and in the same places the seid frye and brode in grete multitude ben daily taken by the fishers there, with unlawful ingynes and nettis for baits of elys and coddes, and also for feding of their hogges, to the utter destruccion of the seid frye and brode without a emedy the rathir be p'vided; That it may therfor please your seid Highness, by the advyce and assent of the Lordes spurelles and temporalls in this p'sent Parliament assembled, and by auctoritie of the same, to ordeyn, establish, and enacte that the maire of London and his successors maires for the tyme beyng have the conservacie and rule, and like auctoritie in e'ry of the seid breches, issus, and crekys and grounde so drowned and overflowen as ferre as the watir ebbeth and floweth, as touching the punnicion for using of unlawful nettes and other unlawful engynes in fishing, like as he and his predecessors hath hadde or hath in the same watir and ryver of Thamys within the boundes afor rehercid, and to do other like correction and punyshment there concernyng the reformacion and redresse of unlawful nettes and angynes, as he and his pocessours have used and owe to use in the seid ryver of Thamys.

Provyded alwey that the maire of London nar his successours maires for the tyme being have not the conservacion nor rule ne auctoritie, in any of the seide breshes, issues, crekes and growndas so drowned and over flowen, within the Kyngis grownd, or being within any franchises of any p'sone or p'sonnes spirituall or temporell, as touching the punycion for using of unlawful nettes and other unlawful engynes in fysshing, nor to doo any correcion or punyshment there concernyng the reformacion and redresse of unlawful nettes and engynes, as the saide maire and his predecessours have used and owe to use in the said ryver of Thamys.

Note 5.

Extract from 27th Hen. VIII., c. 17, 18.

Chapter XVIII.

An Acte for the p'servacion of the River of Thamyse.

Nuisances committed in obstruction, &c., of the River Thames.

Where before this tyme the ryver of Thamys amonge all other ryvers within this realme hath been accepted and taken, and as it is in dede moost commodious and p'fitable to all the Kinges Highnes his estates and nobles, marchauntes and other repayring to the citie of London and other places, shires, and counties adjoynyng to the same, whiche ryver of Thamys is and hath been mooste mete and convenyente of all other for the savegarde and ordering Kinges navy conveyaunce of marchauntdisses and other necessaries to and for the Kinges moost honorable householde, and otherwise to the greate relieffe and comforte of all p'sonnes within this realme, till nowe of late dyvers evill-disposed p'sonnes, partely by mysordering of the said ryver, by casting in of dong and other filth laied nygh the bankes of the said ryver, diggyng and undermynyng of the bankes and walles next adjoyning to the same river, carieng and conveyeng awaye of wayshydes, shores, pyles, bordes, tymbre worke, balest for shippis, and other thing frome the said bankes and walles in sondry places, by reason whereof greate shelpes and risinges have of late been made and growen in the fareway of the said ryver, and suche groundes as lie within the levell of the said water-marke by occacion thereof have ben enrrounded and ov'flowen by rage of the said water, and many greate breaches have ensued and followed there uppon and dayley are lyke to do, and the said ryver of Thamys to be utterly distroyed forev' if convenyent and spedye remedye be not sou' p'vded in that behalve: For reformacion whereof, be it enacted, established, and ordeyned by the King our Souv'aigne Lorde and by th' assent of the Lord spirall and temporall and the Comons in this p'sent Parliament assembled, and by th' auctoritie of the same, that if any p'sonne or p'sonnes hereafter do or p'cure any thing to be done in the annoyeng of the streme of the said ryver of Thamys, making of shelpes by any maner of means by mynyng, digging casting of dunge, rubbisshe, or other thing in the same ryver, or take, plukk, or convey away any bourdes, stakes, piles, tymbre worke, or other thing frome the said bankes or walles, except it be to amende and repair the same agayne, or digge, or undermyne any bankes or walles, excepte it be to amende and repaire the same upon the waterside of Thamys aforesaid, to the hurte, impayryng, or damage of any of the saide walles or bankes, (than [4]) the same p'sonne and p'sonnes, and every of thym, shall forfaite and pay for ev'y tyme so offendyng oon hundred shilling', the oon moytie thereof to be to the King our Souv'aigne Lorde, and the other moitie thereof to the Mayer and Comonaltie of London for the tyme beyng; the same to be recovered and opteyned by the Maier and Communaltie of London by bill, playnt, writte of dette, or informacion, severally ageyst ev'y offendour in any of the Kinges Courtes, in which accions and (suttes [5]) or any of theym, the partie defendaunt shall not be essoyned, nor wage his lawe nor any p'teccion to be allowed in the same.

Penalty on Persons committing such Nuisances 5*l.*, half to the King and half to the City.

For regulating the taking of Ballast from the River between Greenwich and Richmond.

And it is furthere enacted by auctoritie aforesaid, that if complaynt shall happen to be made to the Lorde Chauncellour of Englond, Lorde Treasaurer, Lorde President of the Kinges Counsaill, Lorde Privye Seale, or to any of theym, by any p'sonne or p'sonnes, or body politike, that Sir Thomas Speret, Knight, now having the office and ordering of and for balasting for shippes, or any other that hereafter shall have the said office and order for ballasting of shippes, do take any balast for shippes nere to the said ryver of Thamye, and do not take for parcell of the said balasting the gravell and sandes of the shelpes betwene Grenewiche and Richemound, within the said river of Thamys, or in any place or places that is or shal be to the damage or annoysaunce of the said river of Thamys, or any parte thereof, that (than [4]), upon ev'y suche complaint, the said Lorde Chauncellour, the Lorde Treasourer, Lord P'sident of the Kinges most honorable Counsaill, Lord Privie Seal, and ev'y of theym, callyng bothe the Chieffe Justices of eyther Benche, or oon of theym, shall have power and auctoritie frome tyme to tyme to here and finally det'myne ev'y suche complaynt by their discressions, and to putt such order therin, and for taking of balast for shippes upon ev'y such complaynt as by their discressions shall seme most convenyent for the conservacion of the said river of Thamis; and the parties offending such order shall (suffree*) imprisonment, and make no less fyne than fyve pound to the King use for av'y tyme offending or breaking the same.

(7) Provided always and be it enacted, that it shal be lawfull to ev'y p'sonne and p'sonnes to digge, carye, and take away sande, gravell, or any other rubbyshe, erthe, or thing lieing or beyng in or uppon any shelppe or shelppes within the said ryver of Thamyse, withoot lett or interrupcion of any p'sonne or p'sonnes, or paying any thing for the same, any thing conteyned in this p'sent Acte to the contrary notwithstanding.

Any person may take Gravel, &c., from the shelves in the River.

NOTE 6.

In 16 Richard II., A.D. 1390, it was enacted, "That all filth upon the side of the Thames, next the house of Robert de Partis, shall be utterly removed;" and "that no person do throw, or cause to be thrown or laid, any filth or odure, muck, rubbish, or laystage, in the some water of Thames, of the one side or other, between the Palace of Westminster and the Tower of London, on loss of 10*l*."

By an Act of Common Council of the City of London, made in pursuance of the statute 27 Henry VIII., A.D. 1538, for the preservation of the river Thames, it was ordered, for preventing rubbish entering the river, "That strong grates of iron along the said water-side, and also by the street side, where any watercourse is had into the said Thames, be made by the inhabitants of every ward, so along the said water, as of old times has been accustomed; and that every grate be in height 24 inches at the least, as the place shall need, and in breadth, one from another, one inch." And "if any person or persons, in great rains, or other times, sweep their soilage or filth off their houses into the channel, and the same afterwards is conveyed into the Thames, every person so offending shall forfeit for every default 1*s.* 8*d.*"

In the year 1584, in the mayoralty of Sir Thomas Pullington, and in 1630, in the mayoralty of Sir Robert Ducie, it was ordered 1st. "That there should be no perpresture, encroachments, wharfs, banks, walls, or building of houses in or upon the Thames, to the stopping of the passage."

Item. "That no dung, rubbish, or other filth, be cast into the Thames."

Item. "That no posts or stakes be fixed in the Thames."

Item. "That the fair-way be kept as deep and large as heretofore it hath been."

Again, at Guildhall, 13th May, 1698, Humphrey Edwin, Lord Mayor, it was prohibited for "any manner of person or persons to cast or lay any dung, odure, rubbish, sea-coal, dust, rushes, or anything noyant in the river Thames, Walbrook, Fleet, or other ditches of this city."

NOTE 7.

Extract from Stat. 19 *Charles II., cap.* 3.

Thames-street to be raised three feet.

Thames-street, and the ground betwixt it and the river, shall be made three foot higher.

No building, except cranes and sheds on a wharf, between Tower Wharf and Temple Stairs.

No building shall be erected, except cranes and sheds for present use, within 40 foot of any quay, wall, or wharf bounding the river from Tower Wharf to London Bridge, nor from thence to the Temple-stairs; nor any building (cranes excepted), within 70 foot of the middle of Bridewell Dock, Fleet Ditch, and Turn-mill Brook, from the Thames to Clerkenwell, before the 24th of March, 1668.

Statute 22 *Charles II., cap.* 2.

Key or Wharf from London Bridge to the Temple, 40 feet wide.

There shall be left a quay or open wharf from London Bridge to the Temple, 40 foot broad; and in order thereunto, all buildings, sheds, &c., within 40 foot northwards of the Thames, shall, within eight months ensuing, be taken down and removed, and the buildings to front the said quay shall be of the second or third rate of buildings, observing uniformity as in other streets.

Bridewell Dock to be made navigable from the Thames to Holborn Bridge.

‡ Bridewell Dock shall be made navigable from the Thames to Holborn Bridge, and the ground set out for the breadth of the channel, and of the wharfs on each side, shall not be less in breadth than 100 foot, nor exceed 120, the line of the channel, and the wharfs and levels thereof, together with the cranes and stairs to be placed thereon, shall be ascertained by the Lord Mayor and Court of Aldermen, with the King's approbation, and set out by surveyors before the 1st of May next; the charge to be defrayed by the mayor, commonalty, and citizens of London, out of the fourth part of the imposition upon coals. For giving satisfaction for ground employed as aforesaid, or impaired, and raising of money upon such as are meliorated, the authorities and forms of proceedings in the former Act contained in like cases shall be observed. The return of the quay about White Friers Dock shall not exceed the breadth of 20 foot.

NOTE 8.

It may assist in the elucidation of a principle which I have had the honour of advocating, if I refer to the question of embankments in rivers and harbours, and their effects; and, looking to the mouth of the river, it may be briefly stated, that the general tendency of the action of the sea, upon the eastern coast of England, is to destroy the land, and silt up the estuaries; instances of which have been given by several writers, among whom I may refer to Mr. Lyell, for general cases, and Captain Washington, for a particular one of great importance.*

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* "The whole site of ancient Cromer now forms part of the German Ocean, the inhabitants having gradually retreated inland to their present situation, from whence the sea still threatens to dislodge them.

"On the same coast, the ancient villages of Shipden, Wimpwell, and Eccles, have disappeared; several manors and large portions of neighbouring parishes having, piece after piece, been swallowed up; nor has there been any intermission, from time immemorial in the ravages of the sea along a line of coast 20 miles in length, in which these places stood. Hills of blown sand, between Eccles and Winterton, have barred up and excluded the tide for many hundred years from the mouths of several small estuaries; but there are records of nine breaches, from 20 to 120 yards wide, having been made through these, by which immense damage was done to the low grounds in the interior. A few miles south of Happisburgh also are hills of blown sand, which extend to Yarmouth; and these are supposed to protect the coast, but in fact their formation proves that a temporary respite of the incursions of the sea on this part is permitted by the present set of the tides and currents. Were it otherwise, the land, as we have seen, would give way, though made of solid rock. At Yarmouth the sea has not advanced upon the sands in the slightest degree since the reign of Elizabeth. In the time of the Saxons a great estuary extended as far as Norwich, which city is represented, even in the thirteenth and fourteenth centuries, as 'situated on the banks of an arm of the sea' The sands whereon Yarmouth is built first became firm and habitable ground about the year 1008, from which time a line of dunes has gradually increased in height and breadth, stretching across the whole entrance of the ancient estuary, and obstructing the ingress of the tides so completely, that they are only admitted by the narrow passage which the river keeps open, and which has gradually shifted several miles to the south.

"That great banks should be thrown across the estuary of the Yare, or any other estuary on our eastern coast, where there is not a large body of river water to maintain an open channel, is perfectly intelligible, when we bear in mind that the marine current, sweeping along the coast, is charged with the materials of wasting cliffs, and ready to form a bar anywhere, the instant its course is interrupted or checked by any opposing stream. The mouth of the Yare has been, within the last five centuries, diverted about four miles to the south; so it is evident that at some remote period the river Alde entered the sea at Aldborough, until its ancient outlet was barred up, and at length transferred to a point no less than 10 miles distant to the south-west."—*Lyell's Geology*, Vol. I., 406; *Taylor's Geology of East Norfolk.*

Extract of a Letter from Capt. WASHINGTON, R.N., *to* Capt. BEAUFORT, R.N., *Hydrographer to the Admiralty, respecting Harwich Harbour. See Nautical Magazine,* 1843.

"It is not for me to say who is to blame for the extreme neglect of this port, but that it has been shamefully neglected during the last 20 years is manifest, and thus the best and only harbour on the east coast of England, between the Thames and the Humber, a harbour in which, in a north-easterly gale, 400 vessels have at one time taken refuge, is now all but ruined for the want of a little timely precaution. It is the business of an engineer to report upon the best steps to take in order to arrest any further deterioration, but the more obvious measures would seem to be to put a stop to the daily practice of carrying away the cement stone from the foot of the cliffs, and to adopt at once a vigorous and well-considered system of groyning along the shores; had this been done 20 years ago, a Mortella tower, Rainham's battery, and other fortifications on Landguard east beach, long since washed into the sea, might have been saved; a deep-water channel into the harbour carrying seven fathoms, where there is now a shingle beach as many feet above high-water mark, would have been preserved; the high and low light would still have been available for navigation in the direction in which they were intended; the whole strength of the flood and ebb streams for scouring the channels might have been maintained; a shelter from the sea, caused by southerly and south-westerly gales, would have been preserved; the scouring away of the beach on the eastern face of the town would have been avoided; upwards of 40 acres of good ground, excellent pasture land, with tenements and other property, might have been preserved to her Majesty's Government; but, worse than all, in a national point of view, a harbour that a few years since would have afforded shelter in an easterly gale to the largest ship in the North Sea fleet, is now barely available for a frigate."

APPENDIX B.

LONDON.
River Thames.

No. 283.
Page's Observations on the River and Port.

To counteract this tendency, it would follow, that to judiciously contract the mouth of a river, without diminishing the quantity of water passing up on the flood, and to enlarge the capacity of the river above, from which the water would, on the ebb, operate in the scour of the *embouchure*, would enable the ebb tide to perform this operation with greater effect, acting, as it would, in a narrow channel;[*] and, generally, this is the only part of a river which can be safely embanked without injury to the general navigation.

The importance of the proper management of this great power, viz., the tide, which nature has placed at our disposal, cannot be too strongly insisted upon; the same force which breaks up and denudes our coasts, and blocks up with sand or shingle our estuaries, throws up at the same time into our rivers millions of tons of water every 12 hours, which, by judicious management and timely precaution, may be employed in counteracting the injurious effects of the sea without. Thus in all estuaries filling up with sand, increase of reservoir for the waters of the tide would enable the river on the ebb to clear away the obstructions gradually offered to its course into the sea, and would maintain its depth of channel.

This is not to be attained, however, by any pent-up water, acting by sluices as back-water, which in its discharge resembles a torrent, and produces similar effects, by driving before it, for a very short distance, the mass it is made to act upon, and then leaving it.[†] Such contrivances, though admissible in clearing away mud when no obstruction is offered to its discharge into a stream, become insignificant, and comparatively useless, when applied as counteractions to the operations of the ocean.

It will be evident that the tidal water which operates to keep open the mouth of a harbour is contained in that portion of the river from which the water leaving it at high water would pass through the mouth before it met the flood tide. Taking the Thames at the Nore, for instance, and supposing that all the water contained between its high and low-water marks, for 12 miles up the river, say from the Nore to Holy Haven, flowed out again before it met the flood tide, this water would be available for the scour of the *embouchure*[‡] of the river during the ebb, acting with greatest effect, say from one-quarter ebb to three-quarters ebb, depending on the state of the tides, whether neaps or springs. It would follow also, that if the shores of the river from the Nore to Holy Haven were embanked, the quantity of tidal water contained in that distance would be proportionally diminished, and although the part between the embankment would be deepened by the action of the water from above on this narrowed part, yet the scour at the *embouchure*, viz., beyond the embankment, would be decreased, and there would be formed a shoal. Again, if the Thames were embanked from Holy Haven to Northfleet, the same effects of deepening between the embankments and shoaling below would then be produced; and, in any case, in a tidal river, wherever an embankment were formed excluding the tidal water, viz., the water between high and low-water marks, the scour of the river below the embankment must be diminished, and the effect of such a diminution, viz., a decrease in the depth of water, must result.

It may be here observed, in reference to the importance of tidal water to harbours without rivers, compared with its importance in tidal rivers themselves, that as the scouring power may generally be computed, as before stated, to be greatest from one-quarter ebb to three quarters ebb, the effect of the scour will be proportioned to the quantity of water passing through the mouth of the harbour during that time; and that any water passing out with the first turn of the tide (say from high water to an hour after high water), would be of less consequence to the maintenance of the harbour than water passing out from the first to the second hour after high water, and therefore that embankments which would exclude the quantity of tidal water passing off during the first hour's ebb would not be comparatively detrimental to the harbour; but the case is far otherwise in rivers where the tidal water (except immediately at the mouth), must operate in the scour of the bed of the river at one part or other, until it reaches the *embouchure*; and therefore tidal rivers, so far from forming an exception to the great principle of preserving the capacity for the waters of the tide, on the contrary, strengthen *it*; as, excepting at the mouth of the river, as before stated, any abstraction must be followed by a corresponding effect in decreasing the depth of the water below.

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[*] An apposite illustration of this will be seen by reference to the mouth of the Medway, where the soundings (as noted on Captain Bullock's valuable chart for 1836) are generally 30 feet deeper than in the Thames at the lower part of Sea Reach. The Medway may be said to owe its greater depth both here and upwards, as far as the sand called Bishop's Ooze, almost altogether to the tidal water, and in its channel, which is in the direct line of the flood tide setting in from the German Ocean, the rise of the tide-wave is often six feet higher than at the Nore.

The deep soundings opposite Sheerness fall off again from 30 to 40 feet outside that point, viz., in the wider channel at the Little Nore, where the water is not so deep as in the Thames at Sea Reach.

[†] The course pursued at Dover Harbour will illustrate this remark.

[‡] The mouth of the Thames may be taken at the end of Sea Reach; from thence downwards may be called the great estuary of the Thames and Medway; but the rivers themselves may be classed as estuaries, so long as they have more the character of a tidal wave than of a current.

SUPPLEMENT.

APPENDIX B.
Supplement.

WEXFORD.

No. 284.

No. 284.

WEXFORD.

Extract of a Letter from W. S. DE RINZY, Esq., *to* J. B. FARRELL, Esq., C.E., *on the Dogger Bank and Bar of Wexford*, 1846.

De Rinzy, on the Dogger Bank and Bar of Wexford.

I CAME to reside in Wexford in the year 1818, and from that period until 1824 I was almost daily out boating, and have frequently landed on the Dogger Bank, which was dry, with the same kind of grass growing on it as there is at present growing on the Raven Point. I lived at Curracloe during the year 1820, and kept a boat, and went out fishing almost daily; at that period the deep channel to the north of the Dogger Bank existed, I should say with not less than 9 or 10 feet at low water, the reason I mention this is, that the boat drew more than five feet of water; and although at times there would be a bad sea, the want of water never came into my head, I mean I had no apprehension of striking on the bar. All vessels and fishing boats went out by this channel, even those bound for the Bristol Channel; the direction of it from the point of the port was, I think, about north-east. I have gone on the Dogger Bank frequently to shoot barnacle, and it was so much an island that the grass was long enough to conceal me from the birds; and many kinds of sea-fowl brought forth their young on it. It is my impression, that unless in winter, with a storm from the south-east, this island, at the periods I mention, was never covered altogether.

In 1824, I gave up boating until within the last two years, when I found the face of everything about the bar altered; I have given you my own recollections, but any of the old charts, or Gill's Map of the County of Wexford, dated 1811, will show you the exact direction of this channel, and that there were 19 feet of water on it; and if you get Blackford and Imray's Sailing Directions, or any other, I think they will confirm all I have said, and knowing you would depend on my perfectly disinterested account of these matters, and in order that I might satisfy myself as to the correctness of my recollections, I sent for Powell, with whom I was constantly in the habit of sailing, and without letting him know my object, I asked him such questions that, from his answers, fully confirmed the recollections and opinions I have frequently mentioned to you. I am, as you are aware, a Harbour Commissioner, but being in no way connected with its trade, and having no motive to serve, it would be my most anxious wish to state what was really the case, which I have done to the best of my recollection.

I remain, &c.,
W. S. DE RINZY.

J. B. Farrell, Esq.

No. 285.

List of Wrecks on the coast of Wexford, 1808-44.

No. 285.

ACCOUNT of WRECKS on the S.E. Coast of WEXFORD, from the Bar of Bannow to the north end of Blackwater Bank, a distance of 12 Leagues, during the Years 1808-44, furnished by Mr. William Powell, late Agent for Lloyd's at the Port of Wexford.

Date.	Name of Vessel.	Rig	Cargo.	Total or Partial Loss.	Wind.	Weather.	No. of Lives Lost.
			BALLYTEIGUE AND NEIGHBOURHOOD.				
1809	Foxwell	Ship	Sugar and Rum	Total	S.E.	Storm	
1820	Albon	Ship	Cotton	Partial	S.W.	Partial	
1821	Britannia	Schooner	Fruit	Total	S.W.	Thick	
1822	Lady Warren	Brig	Wine.				
1824	Surrey	Cutter	Fruit	Partial	S.W.	Thick	
1826	Argo	Brig	Barrilla	Partial	S.W.	Storm	
1826	Swedish Brig	..	Barrilla	Partial	S.W.	Storm	3
1830	French Brig	..	Oil and Fish	Partial	S.E.	Storm	
1832	Rumfort	Ship	Cotton Wool	Partial			
1837	James Hadden	Brig	Logwood	Partial	S.W.	Storm	
1837	Maria	Brig	Wine	Partial	S.W.	Storm	
1837	Betsy Miller	Brig	Sulphur	Partial	S.W.	Storm	
1838	Belisle	Brig	Timber	Partial	S.W.	Storm	
1839	Brereton	Ship	Timber	Partial	S.	Storm	
1840	Eliza and Abbey	Ship	Turpentine	Total	S.W.	Storm	
1842	Vermont	Ship	Cotton Wool	Partial	S.W.	Thick	
1843	Santon	Ship	Sugar, &c.	Total	S.W.	Storm	
1843	L'Alfred	Brig	Brandy.				
Not specified.	Prince Royal	Brig	Madder Root	Total	S.W.	Thick, storm	
	British Schooner	..	Oil and Fish	Partial	S.W.	Thick, storm	
	Brilliant Star	Brig	Wheat	Total	S.W.	Storm	
	Caledonia	Ship	Ballast	Total	S.W.	Storm	3
	British Schooner	..	Fruit	Total	S.W.	Storm	
	Ecord	Brig	Ballast	Total	S.W.	Storm	
	British Schooner	..	Grain	Total	S.W.	Storm	8
	Margaret	Ship	Timber	Partial	S.W.		

APPENDIX B.
Supplement.

WEXFORD.

No. 285.
List of Wrecks on the coast of Wexford, 1808-44.

Date.	Name of Vessel.	Rig.	Cargo.	Total or Partial Loss.	Wind.	Weather.	No. of *Lives Lost.
SALTEES ISLANDS AND NEIGHBOURHOOD.							
1809	Neptune	Ship	Wine and Cotton Wool	Total	S.W.	Thick, moderate	
..	British Brig	..	Wine and Brandy	Partial	S.W.	Moderata	
1811	Aimwell	Brig	Pruit	Partial	S.W.	Thick, moderate	
..	Progress	Brig	Timber	Partial	S.W.	Thick, moderate	
1813	Mary	Sloop	Potatoes	Total	S	Thick, moderate	
..	Royal George	Cutter	Grain	Total	S.W.	Thick	
1817	Elizabeth	Smack	General	Partial	S E.	Thick	
..	Lively Kate	Schooner	Grain	Total	S.W.	Thick	
1820	America	Ship	Cotton Wool	Cargo saved	S.W.	Thick, moderate	
..	Fly	Brig	Salt and Fruit	Total	S.W.	Thick	
1822	Hero	Ship	Cotton Wool	Partial	S.W.	Thick	
..	British Brig	..	Coal	Total	S.W.	Thick	
1824	Demerara	Ship	Coffea, &c.	Nearly total	S.E.	Storm	33
..	Prince of Wales	Brig	Pipeclay	Partial	S.W.	Thick	
1833	Shubenacadia	Brig	Cotton Wool	Partial	S.W.	Storm	
..	Rebecca	Ship	General	Total	S.	Fine	
1834	Water Witch	Steamer	General	Total	S.	Thick	6
..	Mary	Sloop	Salt	Total	S.W.	Storm	
1838	Robert Nobla	Schooner	Butter	Partial	S.W.	Storm	
..	Frances	Brig	Grain	Total	S.W.	Thick	3
1841	Maltese Ship	..	Grain	Total	S.	Storm	9
CARNSORE POINT AND NEIGHBOURHOOD.							
1811	Mary	Sloop	Flour and Malt	Partial	S.	Thick, fine	
1814	Jana	Ship	Coffee and Sugar	Total	S.E.	Storm	14
1814	Ruby	Brig	Provisions	Partial	S E.	Snow storm	
1816	Indian Lass	Brig	Cotton Wool	Partial	S.	Thick, moderate	
1818	Erlam	Ship	Coffee and Cotton	Total	S.W.	Fine	6
1819	Tiger	Ship	Sugar, &c.	Total	S.W.	Moderate	26
1819	Ann	Brig	General	Partial	S.W.	Storm	
1819	Sarah	Brig	Timber	Partial	S.	Storm	
1821	Susannah	Brig	Barrilla	Total	..	..	7
1831	Vulcan	Ship	Iron	Partial	S.	Storm	
1834	Zephyr	Cutter	General	Nearly total	S.	Thick, moderate	
1837	Glasgow	Ship	General	Total			
1842	Honour	Brig	Fruit	Total	S.E.	Thick, storm	4
1844	George	Brig	General	Total	S.	Thick	
Not specified.	Waldo	Schooner	Earthenware	Total	S.W.	Storm	
	Victorine	Ship	Wine, &c.	Total	S.	Thick	
	Thomas Peel	Brig	Grain and Potash	Partial	S E.	Storm	
	Brunette	Schooner	Iron	Partial	S.	Storm	2
	Sam	Sloop	General	Partial	S.	Storm	
	Favourita	Sloop	Iron	Partial	S.	Storm	
	Spanish Brig	..	Beans	Total	S.E.	Storm	8
	St. Patrick	Sloop	Coal	Total	S.E.	Storm	4
	Sally	Sloop	Ballast	Partial	S.E.	Storm	
	William	Cutter	Grain	Total	S.E.	Snow storm	6
	Margery and Mary	Brig	General	Partial	S.	Thick, moderate	
	Brothers	Schooner	Salt	Total	S.	Thick	
	British Ship	..	Coal	Partial	S.	Thick, moderate	
	British Brig	..	Barrilla	Total	S.E.	Storm	
	Sally	Brig	General	Partial	W.	Fine	
	British Schooner	..	..	Total	S.W.	Fine	8
	British Brig	..	General	Total	S.W.	Fine	
	Theseus	Ship	Timber				
BAR OF WEXFORD, SOUTH BAY, AND NEIGHBOURHOOD.							
1808	Peter	Sloop	Iron	Partial	S.	Storm	
1812	Wellwood	Ship	General	Total	S.E.	Storm	
1815	Vine	Schooner	Malt	Total	S.	Thick	
1820	Shillelah	Brig	General	Total	N.E.	Blowing	
1823	Thomas Farrel	Brig	Timber	Partial	S.E.	Storm	
1830	Fame	Smack	Coal	Partial	S.W.	Thick	
1837	Shelmaliere	Ship	Timber	Partial	S.	Thick, fine	
1843	Shelmaliere	Ship	Timber	Partial	N.E.	Fine	
Not specified.	British Brig	..	Wina	Partial	S.	Thick	
	British Brig	..	Lumber	Total	S.E.	Thick	
	Mary	Cutter	General	Total	E.	Fina	
	New Friendship	Sloop	Grain	Total	E.	Thick, storm	
	Sultana	Ship	Cottoo Wood	Total	S.E.	Thick	
	Thistle	Schooner	Sallast	Total	E.	Storm	
	Erin	Schooner	Iron	Partial	S.W.	Fine	
	Michael Wickham	Schooner	Grain	Total	W.	Fine	
	Esther	Sloop	Grain	Total	W.	Fine	
	Ellen	Schooner	Coal	Total	S.	Thick	
	Brothers	Brig	Coal	Total	S.E.	Blowing	
	Britannia	Schooner	Coal	Total	S.E.	Blowing	
	Tubbermurry	Sloop	Coal	Total	S.	Fine	
	Native	Sloop	Coal	Total	S.	Storm	
	Marchioness Wellesley	Steamer	Genetal	Partial	N.E.	Moderate	
	John and Esther	Brig	Malt	Total	E.	Storm	10
	British Brig	..	Lumber	Partial	W.	Fine	
	Ponsonby	Brig	Cattle	Partial	W.	Fine	
	Star	Schooner	Coal	Partial	W.	Fine	
	Maria	Schooner	Coal	Partial	W.	Fine	
	Clonmel	Steamer	General	Got off	W.	Fine	
	John and Samuel	Sloop	Potatoes	Partial	S.W.	Thick	

APPENDIX B.
Supplement.

WEXFORD.

No. 285.

List of Wrecks on the coast of Wexford, 1808-44.

Date.	Name of Vessel.	Rig.	Cargo.	Total or Partial Loss.	Wind.	Weather.	No. of Lives Lost.
	BAR OF WEXFORD, SOUTH BAY, AND NEIGHBOURHOOD—*continued.*						
Not specified.	Brothers	Sloop	Grain	Partial	S.E.	Thick	
	British Sloop	..	Grain	Total	N.E.	..	6
	British Sloop	..	Grain	Total	N.E.	..	6
	Chance	Cutter	Coal	Total	N.E.	Storm	5
	Edward	Sloop	Grain	Total	S.	Thick	
	Seaflower	Brig	Grain	Total	S.	Thick	
	General Moore	Brig	Coal	Partial	S.W.	Fine	
	Danish Brig	..	Timber	Partial	S.W.	Fine	
	Portuguese Brig	..	Ballast	Total	S.E.	Storm	
	Hector	Brig	Ballast	Total	S.E.	Storm	10
	Swallow	Sloop	Grain	Partial	S.	Blowing hard	2
	Juliana	Ship	Cotton Wool	Total	S.E.	Thick and stormy	
	Slaney	Brig	Timber	Partial	S.W.	Fine	
	NORTH BAY, WEXFORD.						
1813	Ann	Brig	General	Partial	E.	Stormy	
1814	Sochol	Ship	Glass and Delft	Partial	E.	Stormy	
1838	Paragon	Brig	General	Total	S.E.	Stormy	6
Not specified.	Fame	Brig	Timber	Partial	S.E.	Stormy	
	Peggy	Brig	General	Partial	S.E.	Stormy	
	Hunter	Ship	General	Total	W.		
	Twilight	Schooner	Potash, &c.	Partial	E.	Stormy	
	Eliza	Sloop	Copper Ore	Partial	E.	Stormy	3
	Mary Anne	Schooner	Grain	Partial	E.	Stormy	
	BLACKWATER BANK.						
1812	Hector	Brig	Wine	Total	S.W.	Storm	10
1816	Fair Reaper	Cutter	General	Total	S.	Moderate	
1818	Sprightly	Sloop	Salt	Total	S.	Thick	
18.0	Coquette	Brig	Sugar, &c.	Total	S.E.	Thick	15
1827	Huldah	Schooner	Grain	Partial	S.	Thick	
1828	Ardrossan	Brig	Copper Ore	Total	E.	Blowing hard	
1830	Venus	Steamer	General	Total	S.W.	Thick	
1831	Horatio	Brig	General	Partial	S.	Thick	
1832	Crown	Ship	Ballast	Total	S.	Thick, storm	10
1833	Calcutta	Ship	General	Partial	S.E.	Thick	
1833	Flora	Ship	Sugar, &c.	Total	S.	Thick	
1835	Merchant						
1837	Wild Irish Girl	Schooner	General	Partial	S.	Moderate	
1837	Indian Chief	Ship	General	Total	S.	Thick and fine	9
1837	Water Witch	Brig	General	Total	S.	Thick	
1838	Ariadne	Ship	Timber	Partial	S.W.	Thick	
1839	Perseverance	Schooner	Grain	Total	S.E.	Thick	6
1839	Mercury	Schooner	Coal	Total	S.E.	Thick	
1843	Zero	Ship	General	Total	S.	Thick	
1844	Georgiana	Ship	General	Total	S.	Thick	
1844	James Mattheson	Ship	General	Total	E.	Storm	
1844	Jager	Ship	General	Total	S.E.	Storm	
1844	Albert	Ship	Ballast	Total	E.	Storm	
1844	San Salvador	Ship	General	Total	S.	Thick	4
1844	Minerva	Ship	General	..	S.	Thick	
Not specified.	Abionia	Ship	General	Total	N.E.	Fine	
	Hawk	Schooner	Grain	Partial	S.E.	Blawing	
	Betsy	Ship	Ballast	Total	E.	Storm	4
	Arnan	Ship	General	Total	S.	Thick	
	Swedish Brig	..	Steam Engines	Total	S.	Thick	
	Margaret	Ship	Iron, &c.	Total	S.E.	Thick	
	Margaret	Schooner	Coal	..	S.E.	Thick	
	Argyll	Brig	Sugar, &c.	..	S.W.	Thick	
	Margaret	Ship	Lumber	Partial	S.W.	Thick	
	Barrack	Brig	Timber	Partial	S.	Thick	Crew missing
	Wellington	Brig	General	Total	S.	Thick	12
	Neptune	Sloop	Grain	Total	S.W.	Thick	
	Expedition	Schooner	Slates	Total	S.E.	Thick	
	Blackbird	Sloop	Grain and Bale Goods	Total	S.W.	Thick	
	Laura	Brig	Ballast	Total	S.	Thick	
	American Brig	..	Salt	Partial	S.	Thick	
	Hyacinth	Brig	Coal and Bale Goods	Total	E.	Thick	

County of Wexford, to wit. THIS day, William Powell, of Wexford, late Agent for Underwriters of Liverpool, and joint Agent for Lloyd's, made oath that a list of accidents, in the way of Shipwrecks, which appears in the Wexford Conservative Newspaper of the 18th March last, is, to the best of his recollection, knowledge, and belief, true and correct as far as therein mentioned, including vessels in M. S.—Same Paper.

W. POWELL.

Sworn before me at Wexford, this 8th day of June, 1846, } ROBT. JOHNS, J.P.

Wexford, 8th June, 1846.

This day I saw a copy of the Wexford Conservative Newspaper of the 18th March last, which shows a list of 168 accidents, in the way of Shipwrecks, on the Coast of Wexford, which list I believe to be correct, my having sat as Magistrate adjusting the Salvage on many of the vessels and cargoes mentioned therein; to a great number of which William Powell acted as Agent or Salver.

ROBT. JOHNS, J.P.

From the foregoing Abstract it appears that, in the course of 35 years, 173 vessels have been wrecked on the coast of Wexford, (one-fourth of which occurred on the Blackwater Bank, where there is no light-vessel,) the estimated value of the vessels and cargoes exceeds one million sterling, and the loss of life amounts to 267 persons.

Appendix B
Supplement.

Limerick.

No. 286.
Memorial of the Chamber of Commerce of Limerick.

No. 286.

LIMERICK.

The Memorial of the Corporation of the Chamber of Commerce of Limerick. 1845.

Respectfully Sheweth,

That your Memorialists, representing the commercial interests of Limerick, have frequently found it their duty to call the attention of Parliament and of Her Majesty's Government to the very defective state of the harbour of Limerick, and of the river navigation immediately below that port, which defects remain unremoved.

That in the year 1823 an Act was passed "for building a bridge across the river Shannon, and the construction of a floating dock, for the accommodation of sharp vessels frequenting the port of Limerick," by which the Commissioners of Public Works were authorized to advance the funds necessary for these works, and in consideration of which (and for the repayment of interest and principal of such advance) the merchants and traders consented to the imposition of very heavy rates and duties on their trade and shipping.

That the trade of the port having greatly increased, it was found necessary in 1834 to extend the powers of the former Act for the purpose of building additional wharfage for the shipping, &c., and an additional Act (the 4th and 5th Wm. IV., chap. 84) was accordingly passed, whereby an additional advance was authorized, and the trade and shipping subjected to a further increase of taxation.

That of the advances accordingly made pursuant to these enactments, through the Commissioners of Public Works for the improvement of the harbour, about two-thirds of the amount was expended on the erection of the bridge referred to, and of the approaches and works connected therewith; and the principal design of the above enactments, viz., the erection of floating docks, remains still unaccomplished, though the trade of the port has been subject since 1823 to heavy and increased taxation, now amounting to £4,000 per annum.

That from the position of the port of Limerick, exposed as it is to the prevailing southerly and westerly winds, the necessity of floating docks for the protection of shipping is peculiarly pressing.

The damage sustained by shipping and cargoes in port from two or three gales during late winters, was estimated as exceeding £40,000, a recurrence of which is apprehended every succeeding winter. The obstructions in the navigation of the Shannon immediately below this port consist of rocks and shoals, peculiarly dangerous to shipping from the course of the river for the nearest 10 miles.

That the trade of Limerick is cramped and confined by the difficulties of the navigation above referred to, and the dangerous state of the harbour in rough weather, and at all times for sharp vessels frequenting the port; and that your Memorialists are convinced that had these difficulties and defects been removed at the outset, the increase of trade which has occurred, and to which your Memorialists pray attention, would have been much more considerable.

In 20 years the Customs' Revenue collected at Limerick has increased from £66,929 to £177,316.

The Harbour Income, in the same period, from £846 11*s.* 10*d.* to £4573 19*s.* 11*d.*

Reasoning therefore by this experience, your Memorialists conceive there is ample reason for praying your Lordships to adopt such a plan as will establish this port the key of the river Shannon, to the improvement of which generally Government have already advanced the sum of £534,807, into a safe and secure harbour, sufficient for the present increased trade, but more than all sufficient to promote the commerce of the south-west of Ireland in its developement.

That of this large grant for the improvement of the Shannon, no part whatever has been expended on the port of Limerick.

That the cost of the bridge and approaches thereto, erected under the Act first mentioned, was about £80,000. The whole liability of the port to Government is £124,134. That if from this amount were deducted the outlay on the bridge, the harbour is absolutely in debt not more than the sum of £44,134, for which there is ample security at present in the income of £4,000 per annum; and that as this income will most probably considerably increase, there is ample security upon it for the repayment of such [illegible] l build floating docks sufficient for the trade, and remove the obstructions in the harbour [illegible] ined of.

Your Memorialists therefore pray your Lordships will, under the powers vested in the Act, 4th and 5th Wm. IV., sanction the advance of a sufficient sum by the Commissioners of Public Works for floating docks in the port of Limerick. That you will be pleased to sanction the composition of the debt incurred by the building of the bridge, either under the provisions of the 6th and 7th Victoria, chap. 62, or by a legislative enactment if necessary.

That in the latter event, as heretofore shown, ample security will exist in the amount even of the present income for repayment, and that at all events the increasing trade of Limerick, the vast resources of a district as it were yet unexplored and about to be developed by enterprise for the most rapid transit from place to place, will be sufficient security to Government for an advance for so important a national object as that for which your Memorialists pray.

Francis J. O'Neill, *Vice-President.*
William Carroll, *Secretary.*

To the Lords Commissioners of Her Majesty's Treasury.

No. 287.
Memorial of the Grand Jury of Limerick.

No. 287.

Memorial of the Grand Jury of Limerick.

11*th March*, 1846.

That we respectfully solicit the consideration of your Honourable House to a subject deeply affecting the general and commercial interests of our city, and to which its attention has been heretofore often, but to the present moment unavailingly, called.

That the mercantile body of Limerick submitted to heavy taxation under two successive Acts of Parliament, from the full assurance therein contained of improved accommodation to the shipping interests, by more extended quayage, and by floating docks, the latter being an indispensable condition to the safety of vessels frequenting the port and harbour of that city.

That the former object has been to some extent accomplished, but in the absence of the yet more important part of the designed improvements, we allude to the floating docks—the benefit of the quayage

Appendix B.
Supplement.

Limerick.

No. 287.
Memorial of the Grand Jury of Limerick.

is comparatively neutralized—heavy past expenditure is rendered unavailing—the shipping interest subjected to heavy disadvantages, restricting trade, arresting the commercial capabilities of the country, and subjecting the mercantile body of Limerick to great and constantly recurring loss.

That from the absence of floating docks, sharp-bottomed vessels, essential to valuable branches of commerce, are prohibited from frequenting our port, and that loss exceeding 20,000*l.* has been suffered the last few years by damage done, whether to the works now erected, or to the vessels frequenting the port; and this petitioners undertake to prove if an opportunity be afforded them of so doing.

That the greater part of the large advances made by Government has been absorbed in the building of the Wellesley Bridge, which, however useful to the city, and promotive of the value of the lands brought by it in close contact therewith, has conferred on the trading interests no special or assignable benefit, though the harbour dues payable by them have been the almost exclusive source of repayment of the heavy debt thereby incurred, the toll upon the bridge, which had been also so allocated, having from various causes unexpectedly declined.

That notwithstanding the disadvantages stated, there has been a rapid increase in the trade and shipping tonnage of the city, in proof of which petitioners beg to refer to the following brief and authentic summary:—

Number of vessels reported inwards at Limerick, in the year

1824	was 156, and their tonnage	22,768
1834	,, 222	55,296
1844	,, 502	61,964
1845	,, 585	76,658

Showing a great increase on the last year.

About 20 years ago, there was scarcely one vessel belonging to the port. The present registration of Limerick vessels is as follows:—

55	vessels under	100 tons register.
33	between	100 and 200 tons.
11		200 . 300 ditto.
3		300 . 400 ditto.
2		400 . 500 ditto.
3		500 . 600 ditto.
1	over	600 showing a total of
108	vessels, registering	14,086 tons.

The Custom duties in the port in 1825 amounted to	£66,929
,, 1835	£136,949
,, 1844	£177,306
,, 1845	£192,975

That said trade would be incalculably increased by the completion as aforesaid of the port and harbour, thereby not only increasing the harbour dues, but augmenting the Custom duties, which, in some few years would more than re-pay the necessary expenditure, estimated, as we are informed and believe, at about 40,000*l.*, that in the improbable supposition, contradicted by recent experience, that the trade and commerce of our city, with augmented facilities and advantages should not progress, there is under the second Act of Parliament already referred to a special provision, that on the completion of the port by the building of the docks a certain increase of harbour dues should be contingent, and which, on the sum now derived therefrom, would amount to an income of 1600*l.* annually, which would more than cover the interest payable on the necessary advance.

Petitioners refrain from urging those other considerations in the recollection, they are persuaded, of the Honourable House, they particularly allude to the heavy amount, but not disproportionate to the important objects contemplated, now expending in the improvement of the Upper and Lower Shannon, and its tributary rivers, which must be with a comparatively inefficient result, while the intermediate harbour of Limerick remains in its present condition.

They equally refrain from urging the now paramount necessity which exists to give employment to a people threatened by approaching famine and destitution; they are aware that the peculiar condition of the country fully occupies the attention of Her Majesty's Government, and they are unwilling to suggest that their case requires to be fortified by any temporary emergency, however portentous its character or formidable in its not improbable results. In confirmation of the views which petitioners have suggested, they respectfully refer to the promised report of the tidal commissioners, which they feel assured will fully confirm the statements they have made and in conclusion, petitioners respectfully pray your Honourable House to sanction such an advance of money by Her Majesty's Government as shall build the floating docks herein referred to, and thus realize the advantages originally suggested and held forth to the mercantile body of Limerick.

For self and Fellows,

To the Honourable the House of Commons.

John O'Brien, M.P., *Foreman.*

Inver Bay.

No. 288.
On the want of a Fishery Pier.

No. 288.

INVER BAY—DONEGAL.

On the want of a Fishery Pier in Inver Bay, Donegal.

Gentlemen,

Bundoran, 10th Sept., 1845.

I would beg most respectfully to call your attention to the necessity of having a harbour of refuge erected for the protection of the boats engaged in fishing in the bay of Inver and fishing grounds adjoining.

The bay of Inver, in the county of Donegal, has for a long time been the principal place on these coasts for the herring and sprat fishery, and which would (if carried to the extent it might be) give profitable employment to both the inland and sea-coast population, but in consequence of the great annual loss of boats and tackle sustained by the fishermen, for want of a harbour of refuge to protect themselves and their boats in stormy weather, the number of men and boats engaged is not one-third so great as it might be.

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Supplement.

INVER BAY.

No. 288.
On the want of a Fishery Pier.

The winter fishing (which I am informed was very good) is entirely lost, as, in case of a storm, there is no safe harbour nearer than six miles from the fishing grounds. There is at present the remains of an old quay adjoining a small valley called the Port, opposite to which the fishing is principally carried on, and which, if rebuilt, and extended but a little, would be of the greatest benefit, as well to those engaged in fishing as to any vessels which might put in from stress of weather, there being 12 feet at high water at the point of the present old quay.

I have, &c.,
R. ST. GEORGE JOHNSTON.

To the Tidal Harbours Commission.

No. 289.

Answers to Queries respecting Inver Bay.

No. 289.
Answers to Queries.

There are about 550 boats connected with the port, averaging from one and a half to eight tons each.

There are generally about 3,000 fishermen employed in the fishing season, the greater portion of whom are married men with families, all depending on their success in the fishing for support.

The present pier, or remnant of such, is in a state of dilapidation, and were it not for the exertion of fishermen, who annually build up the stones and rocks for their landing, they could not get ashore. The foundation remaining of the pier is well constructed and good.

The tide rises at the pier-head in calm weather to 12 feet perpendicular, and in stormy weather from 14 to 15 feet.

The tide leaves the pier-head a distance of 30 yards, but if the present foundation, 100 yards long, is built upon and completed, it would answer all the purposes of the fishermen, and even for coasters of 120 tons burthen.

There is plenty of the best materials at hand or very convenient, and great facility for the execution of the pier. The probable cost would be about 500*l.*, but some private funds can be raised, and a great deal of expense would be saved by the labour of the fishermen, who would assist at the work for a certain time most cheerfully.

No. 290.

Extracts from Captain BEECHEY'S *Report on Packet Stations in the Irish Sea.*

No. 290.
Extracts from Beechey's Report on Packet Stations in the Irish Sea.

1st October, 1837.

LARNE is the next port to which I wish to call their Lordships' attention.

In point of security and facility of access, this port is without a competitor on the north-east coast of Ireland; and without entering the Loch of Belfast, is the nearest port to that great commercial town and to the port of Loch Ryan. It has also the advantage of being particularly well situated for the mail communication with the north of Ireland.

The only disadvantage this port possesses is that of having a dangerous rock off its entrance, situated between it and the Maidens. This danger may, however, be removed by blasting the rock to a sufficient depth for the vessels of the steamers' draught of water to pass over it. Besides, with the Maiden Lights on the north, and Larne Lighthouse on the south, it could hardly occur that a vessel would be upon it before she had warning of her situation from one or the other.

A very small sum will render Larne complete as a station; there is already a jetty there, which will be at the service of the packets; and if this be used, a sorting-house for letters will be all that is requisite. But, I should recommend a wharf being built in the vicinity; perhaps in the place I have assigned it in my plan, and kept exclusively for the use of the packets: the jetty being very slight, will require constant repair, and it seems to me to be too near to the entrance to afford the requisite accommodation during north-easterly gales. It may happen, moreover, that the steamers trading to the port may be discharging or taking in their cargoes at the moment the packet would require its use; and as no more than one vessel can lie alongside it at low water, that circumstance would occasion an inconvenient delay.

A wharf, in the situation before mentioned, will require to be only 176 yards in length, to command 17 feet water at all times, and there is an abundance of lime and stone fit for its construction in the immediate vicinity.

Annexed is a copy of the petition of the inhabitants of Larne to the House of Commons, in which I entirely concur, with the exception in the gain in point of time in the mail deliveries, stated in section 6, and the depth of water alongside the jetty, which is 12 instead of 14 feet.

As regards the passage between Larne and Cairn Ryan, it may be performed nearly as expeditiously as that between Portpatrick and Donaghadee, by the employment of competent vessels which the contracted limits of Portpatrick will not admit of: besides the mail from Glasgow arriving earlier at Cairn Ryan, the packet will be able to start two or three hours sooner than she now does, and there will be no delay from the state of the tide.

In fact, I cannot point out two ports better situated, and more unexceptionable, than Cairn Ryan and Larne.

Loch of Belfast.

The loch of Belfast is next in order in point of distance.

Throughout all this loch, there is not a place, accessible at all times of tide, at which vessels can ride in perfect security with all winds; and to construct a port for the occasion would require a very considerable outlay, as below Garmoyle the sea rolls heavily in with easterly gales. It is, however, in contemplation to cut a channel from Garmoyle up to the quays of Belfast; and I am informed by the corporation of that town that the work will be commenced in the ensuing spring, and that in January, 1839, it will be so far completed as to allow vessels drawing nine feet water to come close to the town at all times of tide.

If this be accomplished, in 1839 the port of Belfast will afford all the accommodation that can be required by the packets. But by adopting this port the sea passage will be increased 20 miles; and unless the mail from Glasgow can be conveyed to Cairn Ryan three hours earlier than at present, all the north and west parts of Ireland will suffer in their correspondence by the arrangement, the former 24 hours, and the latter 12 hours, as will appear in speaking of the mail conveyance with regard to Larne and Cairn Ryan.

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Supplement.

No. 290.

Extracts from Beechey's Report on Packet Stations.

I cannot, therefore, recommend this route in preference to Larne.

The increase of sea passage is a disadvantage, and the delay that must take place in navigating the loch in thick weather, from the shoals on either side, and in hitting the narrow entrance of the proposed channel to Belfast, is a still greater objection. Besides, with deference I speak, in order to render the stations permanent, it seems necessary to adhere rigidly to the principle urged by their Lordships, as the numerous railroads in progress and in contemplation will no doubt ultimately convey the mails with the greatest possible rapidity to the two nearest possible points of communication.

The Chamber of Commerce and Corporation of Belfast are very anxious that that town should be made the packet station on the Irish side "if practicable," and I have given the subject much consideration; but, I do not think, if their desire were granted, the communication with Scotland would be attended with that regularity which they think of such importance in commercial transactions. Thick weather, south-west gales, and a strong ebb-tide down the loch, would so retard the arrival of the mail that it would occasionally derange all the correspondence.

A railroad from Larne to Belfast, which has already been in contemplation, would do more towards accomplishing their wishes than fixing the packet station at their town; as they would then, no doubt, with the help of the railroad from Glasgow to Ayr, gain a whole day in their correspondence with Scotland.

Donaghadee.

There is no serious objection to Donaghadee Harbour as a packet station, as it is situated upon a weather shore during the prevailing wind, and is frequented by the packets during daylight only, and that for not more than an hour or two at a time.

It is certainly very small, and for the most part very shallow; but there is a sufficient depth of water alongside the southern quay for a large-class steamer, where she may, in general embark carriages and passengers very conveniently. This may always be done with the wind from north round by the west to about south-east, as the harbour is then tranquil; but when the wind draws to the eastward of these bearings, the sea rolls in, and the vessels ride heavily, and can with difficulty be prevented damaging themselves against the quay and each other. At high water this is much increased, as the sea then finds its way in both at the entrance of the port and by the western end of the northern quay.

In consequence of this cross swell, vessels are obliged to haul off from the quay on the approach of bad weather, and to lie with their heads across the harbour. Their cables and anchors are of necessity carried out in the same direction, and stretched directly across the entrance of the harbour, and are thus liable to be carried away by vessels running in; and there is no possibility of avoiding this, as the deep water is confined to a small space only on the south-eastern part of the harbour.

There is no difficulty in making the harbour of Donaghadee; it may be approached with safety in any weather. The Copeland Islands have a good light at night, and are bold; there is also a good harbour light, and in thick weather the bank, called the Rig, is an excellent guide to a vessel to the southward of the Copelands.

With an easterly gale, however, it would be very dangerous to take the harbour in any vessel that did not lose her way readily on a back turn of the engine, and which was not of very small draught of water.

The "African" would inevitably run aground, were she to attempt the port under such circumstances.

I have the honour to annex a sketch of the port, for their Lordships' inspection, a reference to which will furnish more information than any description which I can give in writing. It will there be seen to what a small part of the harbour the deep water is confined; that there is only six feet in the centre at a distance of only 240 feet from the entrance. To avoid this, a vessel must haul short round into the south-east angle of the port, and instantly deaden her way, to escape running against the pier; were she to drop her anchor under foot at low water, she would be liable to be damaged by the fluke. It will also be seen, that there is a large space between the western end of the north pier and the wharf B, through which at a quarter-flood the sea is admitted to the harbour, and with easterly gales rolls in with great violence.

These defects, which it must be admitted render Donaghadee extremely objectionable as a harbour of refuge, do not incapacitate it from being continued as a packet station; for whenever the wind is in an unfavourable quarter for the tranquillity of the harbour, it is favourable to the passage across from Portpatrick, and the packets arrive early and depart during daylight: on the contrary, when they are delayed until after daylight, which can only be with westerly gales, the harbour is smooth and safe of entrance. But were this port in the situation of Portpatrick, it could not be frequented with safety.

Should it be ever their Lordships' intention to improve this port, much might be done with a moderate outlay. The harbour might be deepened to 10 feet all over as far as the old pier, and a rough rubble breakwater might be constructed at a small expense upon that part of the harbour which dries between the wharf B. and the northern pier. It would not be necessary to carry this the whole of the way; an opening of 140 feet might be left with advantage to the port, near the west-end of the pier, to solicit the direction of the wave which finds its way in at the entrance E., and thus lessen the rebound of the water towards that part of the harbour occupied by the shipping; it would also afford an easy egress, with particular winds, to small craft quitting the port at half-tide.

Had this harbour been constructed for steam-vessels only, the entrance would no doubt have been differently placed; at present there is shelter on neither side of it with easterly winds, but if it had been at the north-east angle, two-thirds of the harbour would have been available with all winds, especially if the breakwater had been carried out from the wharf B., and buoys might then have been laid down to mushroom a screw moorings on the south side of the entrance, without obstructing the passage or endangering the bilging of vessels coming in. Vessels steadied between them and the rings in the piers, would have been able to ride in safety to themselves and others, which is far from being the case at present.

The space H., within the old pier, being more protected, would then have formed a good dry harbour for small vessels, and thus have freed the outer harbour from an incumbrance at present extremely inconvenient.

Correspondence.

In No. 18, Mr. Davies, the harbour-master and chief officer at Donaghadee, offers some remarks upon the report made by Commander Evans on Donaghadee. He is of the same opinion at present as he entertained at that time; states that the danger apprehended from the height of the lighthouse has not occurred, but that it is unnecessarily high.

APPENDIX B.
Supplement.

DROGHEDA.
River Boyne.

No. 291.

Nimmo, on the Improvement of the Harbour.

No 291.

DROGHEDA.—RIVER BOYNE.

Report of ALEXANDER NIMMO, *C.E., on the Improvement of the Harbour of Drogheda.*

London, 10*th May*, 1826.

THE harbour of Drogheda is formed by the outfall of the river Boyne, which, assisted by the ebb from a considerable tide basin below the town, maintains a channel through a beach of near a mile broad.

To form some idea of the scouring power of this river, I may observe that the Boyne rises near Tyrrel-pass, about 50 miles above Drogheda, and between these points and Lough Ramore, it drains a country of 700 square statute miles, and delivers about 3,000 cubic feet of water per second in ordinary times at the bridge. The river meets the tide about a mile and a half above Drogheda.

The tidal basin below extends over a space of 460 statute acres; it is 7,000 yards in length from the bridge to the narrow between the sand hills called the Crooks, gradually widening from 160 feet at the bridge to half a mile at Beltra, and then suddenly contracting to a breadth of 160 yards at high, and 90 yards at low water. This space contains, at high water, 3,600,000 cube yards, or 97½ millions of feet. The tide in that basin at ordinary times flows 4 hours 20 minutes; and ebbs 8 hours 5 minutes. The proportion of fresh water during the flood tide will, therefore, be 46 millions of feet, or nearly half the contents, the remainder being salt water from the sea, and the quantity discharged by the ebb will be 87 millions from the river in addition to the tide, or 184 millions of feet in all, nearly double the other, which accounts for requiring nearly double the time of discharge; this will give about 6,323 cubic feet per second as the average discharge during the ebb.

These proportions are of course much altered in freshes and draughts, for at times there is hardly any time of flood running up the Boyne, and they are stated only to draw general conclusions.

Now, the area of the section at the mouth of the river, between the sand hills at high water, is 4,500 square feet above low water level, and 960 below. I found the velocity $5\frac{4}{10}$ feet, per second at ¾ ebb, so that the section below low water is sufficient to discharge the whole river water during ebb, and the tide water may be taken as passing through an area 4 500 feet gradually lessening to zero, which may be averaged at 2,250 square feet. In 8 hours 5 minutes, the time of ebb, this will discharge the whole contents of tide water 97 million feet at the rate of 1½ feet per second, and as the velocity will, when greatest, be about double that, or two miles per hour, it is sufficient to remove sand, none of which lies in this part of the channel in consequence of this powerful scour from the river.

The channel below the Crook is cleared of everything lighter than heavy shingle and stones, showing the velocity of ebb to be still stronger there than in the Crook. Indeed, as I found it at ¾ ebb to vary from four to six feet per second, there must be a considerable fall in the river from thence to low water.

Above the Crook the basin expands to the width of half an Irish mile: whatever sand may be carried in by the tide from sea is inevitably deposited immediately above this narrow opening, accordingly the channel through that portion seems always to have been irregular and obstructed by shoals. The chief operations now wanted are in that neighbourhood.

Above these shoals the channel has been confined by means of low weirs of gravel and clay to an average breadth of 70 or 80 yards, and though this has been irregularly done, yet the depth throughout being greater than on the shoals below, no inconvenience is at present felt.

This operation was begun under the direction of Mr. Golborne, who also suggested a similar course of operations upon the Clyde, and though incomplete on the Boyne, it has evidently produced a material improvement in the upper part of the channel.

We have a map of the river drawn forty years ago by Mr. Sherrard, previous to the commencement of these operations, and though the depths marked by him at low water cannot be exactly compared with ours, not having been referred to any given level, yet they are sufficient to exhibit the very striking change which has been produced since that time. The outline in his time and the depths are marked in red on the present map, and the comparison of them is highly instructive.

The first reach runs due east per compass, and from the bridge to the end of the quay there appears a regular increase of about two feet of water. Near Elliott's Wall, which is the oldest on the river, the increase is above three feet, and the ford at that place has entirely disappeared, the depth being now twelve feet.

The next pool or reach runs along the north shore E. by S., and opposite the bridge at Green-hill, is also 12 or 13 feet deep, and was then only six; this depth is unnecessary, and the jetties on the north side should be shortened, as they seem to have thrown up a shoal below Green-hill, where we have now only five feet where Sherrard marks seven; new jetty weirs are, therefore, required upon the south side, which would restore the original depth on this shoal.

The next reach passes E.S.E. obliquely over to the south shore at Branagan's Point; it has a regular straight weir along the north side, and is greatly improved, having increased four or five feet as far as the new quay. Beyond that quay the channel has been shifted to the north, by means of the jetties, and the depth improved by two or three feet.

The next reach returns E. ½ N. obliquely to the northward, below Mornington. There appears to have originally been two extensive banks in this reach, with swashes or shallow channels over them on the south side, and between these a wide space called the Man-of-war Roads. The channel is now confined to the north side of these banks, and the broad place between them entirely filled up; the depth of water, however, in the channel is generally increased, but the shoal called Banktown Ford still exists at this place with only three feet water.

The new channel appears to have been unskilfully managed below this, and very little improvement attempted; it turns off two points more to the northward than before, the long jetty on the south side having been protruded beyond the regular line of weirs, and the short portion executed of the weir on the north side drawn too much towards Beltra, so that at the turning post of the channel makes a quick rant off S.E. to the Crook, and though it has gained considerable depth, seven feet through this bend, called the New Deep, the benefit is immediately lost in the next reach called the Swash, where we have only 3½ feet; some attempts have been lately made to remedy this by two short jetties at the swash; but the proper cure would be to form an entire new channel from above Banktown Ford, across the old swash-way more direct to the Crook, and to secure the sides with weirs and jetties. I have delineated the course of this proposed channel upon the plan; the greater part of the excavation, which would be taken up by the dredging engine, may be deposited as a bank on the south side, so as also to direct the back water from the creek within the south point to the channel above the ford.

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It must not be denied that this operation will be materially more expensive than dredging down the fords in the present channel; but it will frequently admit of vessels sailing which are at present wind-bound when the wind is from the north.

Hitherto the tide of ebb being in a wide estuary, has been comparatively gentle, and the bed of the river is sand and fine gravel; but, on passing the narrow entrance between the sand-hills, the velocity is rapidly increased, as has already been observed, so as to exceed, at low water, 5 and 6 feet per second, the whole backwater—about 500 acres—passing through an opening of 160 yards at high water. No sand can lie in the channel with this velocity; and it continues between the points, and for 300 or 400 yards, to have six feet in depth with a bottom of stones and heavy shingle, which is evidently not the result of any deposition.

The direct passage to sea is obstructed by a bank called the North Bull, the inside of which is composed of stones and gravel, on which there is five feet at high water, and the channel is thereby turned along shore to the southward or S. by W. for half a mile. In this reach it crosses a shoal of stones and gravel called Rock Shod, on which are only four feet at low water; afterwards as far as the Maiden Tower, we have the long pool with seven to nine feet.

The sudden bend at the Crook and the Rock Shod are among the chief difficulties of the navigation; for the early ebb, setting right across the Bull to sea, carries ships upon the north bank when sailing from the river; and in like manner the last of flood shaves them over to the west side, or Carrick, ere they have entered the Crook; hence vessels are most commonly grounded at this bend, or on Rock Shod.

The cause of this seems to be misunderstood when an attempt was made to dig another channel across this bend, and as the ebb and flood naturally keep the present direction, that channel has accordingly filled up.

The proper cure is to heighten the inner part of the North Bull by a bank rising to the level of high water, which will prevent the tide from setting over it, and guide it fairly along the channel. This bank may be made by wheeling up the stone and shingle to be found on the spot, and it may be aided by dredging down Rock Shod to a proper depth.

I propose to carry the bank as far down as the Maiden Tower at least, as thereby we form all this reach into a sheltered harbour, where vessels may be water-borne to wait for a fair wind, and below all the windings of the channel. They will also be more accessible than in the higher parts of the river. The bank must be sufficiently far from the present channel to prevent any risk of having it washed in, and being formed with large slopes, will be sufficiently secure without walling; in a few years it will probably be backed up with sand; and it forms a towing path for vessels through the Crook and Long Pool.

When we pass the Maiden Tower the channel of the river turns off to sea, and here only is it liable to any alteration. The unknown antiquity of Maiden Tower shows the cause of the bend at this place to be permanent, and, accordingly, we find a bank or shoal of stones and gravel called the rough ground on the south side of the channel, which is evidently an original bed, connected with that under the North Bull, and at Queenborough and Mornington.

The lower end of this is called Tickel's Bed, and is composed of materials somewhat finer, and possibly washed down from a higher part of the channel. Properly speaking, this shoal is the only bar of the river, the depth over it being only two to two and a half feet, increasing regularly to five and six feet without; which depth continues to a little beyond the bar perch, and then increases speedily to ten feet and upwards. The form of the channel at the bar is distinctly shown on the chart by the lines of three feet and six feet water, and it may be observed that it has a slight turn to the north, the ebb from the river running for an hour or two longer than in the offing, the last quarter falls in with the flood to the northward.

It appears from tradition, as well as from the position of the small obelisk behind the Maiden Tower, that the entrance up the river has been to the north as well as to the south of its present place, but without any remarkable change in the depth of water on the bar, which seems always to have corresponded with that of Tickel's Bed aforesaid. If, therefore, a passage were cut through that shoal, and the banks to sea lined with matter of similar density, there seems no reason to doubt but a depth of five or six feet water may at once be obtained and preserved into the harbour of Drogheda. A feeble attempt has been made to cut obliquely across Rock Shod, and Tickel's Bed, and the stuff has been laid up on the north side of the river; but although some additional depth has been obtained this way, the direction chosen appears to me to have been awkward and injudicious, and such as can never be made intelligible to a stranger. The passage ought to be cut at once by the steam-engine, so as to unite as directly as possible the portions of the channel above and below, and as the matter of which this shoal is composed will rise easily with the dredging-engine, there will be no great difficulty in doing this, and boating it to wherever it may be wanted. The stuff cut from the shoal should be deposited along the north and south sides of the entrance; that on the south being a kind of lining to the channel through the sands as far as the bar perch, and that upon the north side being placed so far off as to prevent its being washed in by heavy northerly swells. It will thus act as a kind of pier for the north side of the channel, and when brought up to low-water mark, a break-water pier should be begun upon it of heavy stone firmly packed together, and brought above the level of high water. This breakwater will protect the entrance in northerly gales, which are now the most dangerous. I have drawn it upon the plan in the direction of the outside of the Point of Skerries, and of course in all other than the land winds there will be some shelter under its lee, and it may be gradually extended as funds for its construction can be obtained. There is no such necessity for a similar construction on the south side, as the southerly winds make always high tides and smooth water on the bar. The transverse section of these works are shown on the plan.

The result of the operations I have now proposed will be:

1. To produce an increase of four feet more water into the channel of the Boyne, not only over the bar, but all the way to the quays of Drogheda, with a safe and more direct navigation.

2. To shelter the entrance, and produce smooth water on the bar in the north-east winds, which cause at present the most violent breaker.

To cover all the reach above the Tower, and form there a sheltered harbour, with eight feet water, where the outward bound may lay below all the winding of the channel, and more accessible than at any other part of the river.

To give a towing path along this reach, so that vessels may always put to sea when they can leave the quays, and *vice versâ*.

To prevent the vessels grounding at Rock Shod by the thwart side below the Crook.

To permit vessels to sail from Man-of-war Road with the wind two points more easterly, and *vice versâ*.

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DROGHEDA.
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No. 291.
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And, lastly, so to fix the channel at the mouth of the river that a considerable increase in the depth over the bar may be confidently anticipated.

The plan I have now given for attaining these important advantages is so very simple and economical that it may appear, perhaps, to some persons, inadequate to the purpose; but I trust the Commissioners of the harbour of Drogheda, with their experience of the great results that have been produced by similar means, will not be diverted from this to the laying out their funds upon extensive works of masonry, or the like, which are expensive in construction and repair, and can never give equal satisfaction. The only work for which materials will not be found on or near the spot is the breakwater or the North Bull; this will require heavy stone, which may be brought by barges from the quarries near Drogheda, or by sea-going craft from the island of Lambay, where some of an excellent description may be had, with a convenient pier for shipping it.

I am, &c.,
ALEXANDER NIMMO.

Estimate for the Improvement of the River of Drogheda.

To forming an embankment or weir of stones and shingle from the North Crook to the Maiden Tower, 38 yards average section at 1*l.* 10*s.* per yard.—1,200 yards at 1*l.* 10*s.*	1,800	0	0
Dredging passage through the rough ground, and Tickel's Bed shoal, 60 yards wide to the depth of 6 feet—32,500 yards at 1*s.*.	1,625	0	0
To barging this stuff to the weirs or banks on each side of the river's mouth	812	10	0
Dredging passage through Rock Shod and Carrick, 60 yards wide—12,000 yards	600	0	0
Barging same, and discharging on east weir, and for new cut at the ford	300	0	0
Rough stone for mole or breakwater at north side of the bar, 65 yards at 4*s.*, and paving surface of same at 5*s.* is per yard, running 19*l.* 10*s.* say 20*l.* for 100 yards.	2,000	0	0
Passage cut through Bankstown-ford to the Crook, 950 yards long, 0 to 3 deep, and 60 wide at 9*d.*	3,982	10	0
Contingencies, &c. 20*l.* per cent.	2,224	0	0
	£13,344	0	0

ALEXANDER NIMMO.

LANCASTER.
River Lune.

No. 292.
Beasley, on Improving the Channel of the Lune.

No. 292.

LANCASTER—RIVER LUNE.

WM. BEASLEY, Esq., C.E., *on the best means of Improving the Channel of the River Lune.*

GENTLEMEN,

Surfleet, 10th March, 1846.

In compliance with your request conveyed to me through Mr. Walker, I have viewed the bed of the River Lune, and I now proceed to give you my opinion as to the best manner of improving the channel from below Lancaster to Glasson Dock. In the first place, as the operations which I shall submit to your notice may be somewhat new to you in their application, I think it right that I should briefly explain to you the principle of carrying them out, as well as the benefits which I feel confident will result from them. The present imperfect state of the navigation of the Lune, similar in every respect to other tidal rivers which run through an open estuary, is caused, in my opinion, by the constant shifting of the channel, and the circuitous and uninterrupted course which it has the liberty of taking in so large and uninclosed a bay as that which lies between Lancaster and Glasson Dock, where there is such a space for the tidal waters to flow over without any training or restraint, it is quite impossible but that numerous shoals and other serious obstructions should be created in the bed of the river, and that at times it should be almost choked up, unless there be a sufficient quantity of freshes to scour it out and remove them.

In the absence of such a powerful agent (which it is quite clear the Lune has not), and bearing in mind the cause of the impediments to the navigation, it is obvious, that the only principle to be applied for effectually improving the river must be contracting and confining it in width, trusting to the freshes for deepening it, and carrying off obstructions of the nature of sand and silt, which would readily give way to their force, and relying upon dredging for the removal of other impediments, such as clay or gravel which the scour is not able to stir. I feel confident that the adoption of this principle would be attended with the most complete success; and that instead of the present unsafe shallow and winding channel, the Lune, from being made uniformly narrower and straighter, would not only obtain, but would also preserve a sufficient depth of water to be navigable at all seasons for vessels of very large burthens. I think, moreover, that by providing for the tide a more confined and direct course, it would reach Lancaster Quays almost an hour earlier than at the present time. Seeing, as I do, no difficulty in making many important improvements in the navigation of your river, I now beg to submit to your consideration the following plans for effecting them:—

In the first place, I would train down the channel by erection of fascine embankments in nearly parallel lines on each side of it, beginning at the highest point to which it is desired to make the improvements, and carrying them progressively forward through the estuary in as direct a course as the situation of Glasson Dock will admit of. Their height and strength will depend entirely upon circumstances; but at all events they should be sufficiently substantial to confine as much as possible the body of freshes within them, for the greater the bulk of water brought down, and the more confined it is in its course, the greater will naturally be the scour in the bed of the river. I recommend fascines not only because they are much cheaper than stone from being generally to be had close at hand, but also because from the experience I have had of their efficacy in the rivers Witham and Welland, in Lincolnshire and elsewhere, I feel convinced they are far preferable; for, being pervious in their nature, they readily admit the free ingress of the sand and other deposit brought up by the tide, and thereby become very quickly consolidated. To prevent their being floated away when first laid down,

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it is necessary to lay some heavy substance upon them, but only just so much weight is required as would be sufficient to hold them against the flow of the first few tides. For this purpose nothing is better to be used than the gravel which will have to be dredged out of the bed of the river, where the scour will have an effect; and I think quite sufficient will be raised from it to secure the whole works.

I may here observe that, in addition to strengthening the works, the tides being checked in their return by them from flowing bodily back into the channel, will be found to deposit behind them the mud and other floating particles which they bring up, and thus a process of warping or accumulation will take place, which will gradually raise the sands to a level with the present salt marshes, and ultimately make them high and available land. By acting upon this principle of forcing an immense volume of water, which previously ran in its own free course, to flow in one restricted channel, it is made its own agent in procuring depth; and you may rely upon it that the great scour consequent upon contracting the Lune, with perhaps the occasional use of a dredger (there being, according to Mr. Stevenson's survey, as much as 11 feet fall between Lancaster and Glasson Dock), will keep it open in the driest seasons.

Not having had much experience of the rapidity and weight of the freshes, I cannot calculate the exact depth which they will give, but it will always be as great where they can operate as in those places in which it must necessarily be dredged: thus, assuming that you desire to have a depth of 16 or even 18 or 20 feet at Lancaster New Quays at ordinary spring tides, and that you dredge all the shoals so as to have that quantity of water over them, you need feel no alarm as to the other obstructions in the bed of the river being naturally removed. Now first as to the dredging,—it appears from Mr. Stevenson's plan that there are at intervals between Lancaster Quay and Glasson Dock about 2742 yards of gravel through which the channel will have to be dredged; estimating the expense of this part of the operation so as to give a depth of 16 feet over them at ordinary spring tides, for large vessels it will be necessary to take out about 100,000 cubic yards, which will cost something like 5000*l.*, not including the outlay for a dredging-machine and other necessaries. I may here be allowed to remark, that in my opinion no permanent improvement would arise from dredging alone, for unless the channel be trained, there would be nothing to restrict it to the course dredged out for it, or to prevent it from following any other direction. I should not, therefore, recommend that any portion of the expenditure be incurred unless it be determined to commence contracting and confining the channel at the same time. Another thing to be considered is, that by carrying out both operations simultaneously, the cost of the dredging will be entirely saved. If no dredging had to be done, it would be necessary to employ several boats to fetch materials from the shore to be laid upon the works; but as I suggested before, that nothing could be more suitable for this purpose, from the tenacity of its composition, than the gravel brought up from the bed of the river, the expense of getting it up must not be taken into consideration. It has been intimated to me that the Commissioners have some idea of placing the New Quays below the Old Ford, near what is now called the New Quay. If that suggestion be adopted (and I see no reason why it should not, as it will only involve the trifling additional expense of lengthening the contemplated tram road from the town), the new improvements would commence at this spot. I would in that case begin by heightening the present sea wall or weir on the north side, so as to prevent the fresh waters from running over the Old Marsh; and then from the end of it I would carry on the line of fascine embankments in as direct a line as possible towards Snatchem's, constructing at the same time a similar work on the opposite side. I think 70 yards would be a proper width to commence with, which I would increase about 17 feet in every mile. At Snatchem's I think the channel should take a curving direction to Heaton Point, and then be carried in a straight line to a place on the opposite shore called Nan Brecks in the map, whence being continued and passing along in front of Waterloo, it might be brought gradually and easily round, so as to carry its waters close past the entrance of Glasson Dock.

I should much prefer training the channel through the middle of the estuary in a more direct course for Basel and Sunderland Points, but I am instructed to bear in mind that Glasson Dock cannot be lost sight of.

Now the distance between the New Quay and Glasson Dock by my proposed line being about 5 miles, I estimate the cost of completing the whole works at 40,000*l.*, or at about the rate of 8000*l.* per lineal mile.

If extraordinary exertions are used, the whole operations may be completed in three years. As works of this nature must, from their construction, be gradual and slow, I would advise that for the present the idea of completing the whole distance should be abandoned, as I feel convinced that most important improvements would accrue to the navigation, from the outlay of one half or less than one-half of such sum; and the Commissioners would then moreover have sufficient experience of the efficacy of the works to guide them as to their future proceedings. The expenditure of one-half would open a permanent channel down to a distance of more than two miles below Lancaster, and through Colleway Shoal, the last serious obstruction in the bed of the river on the upper side of Glasson.

I can only add, in conclusion, that if my advice or assistance should be at any time further required, I will give it to the best of my ability, and also that if any works are intrusted by you to my guidance, I shall always devote my best energies to them.

I beg to acknowledge the valuable assistance which I received from those gentlemen who accompanied me on my view.

I remain, &c.,
WM. BEASLEY.

To the Commissioners of St. George's Quay, Lancaster.

APPENDIX B.
Supplement.

CHESTER.
River Dee.

No. 293.
Proceedings of the River Dee Commissioners, 1820.

No. 293.

PORT OF CHESTER.—RIVER DEE.

Proceedings of the River Dee Commissioners.

At a Meeting of the Committee of the Commissioners appointed by the River Dee Acts, held at the Exchange, in Chester, on Friday the 1st of September, 1820,—

Present:—The MAYOR of Chester; Alderman NEWELL; Alderman Henry BOWERS; Alderman FRANCIS; Mr. RIGBY; Mr. HANCOCK.

Mr. TELFORD having, pursuant to the resolution of the last meeting of the said Commissioners, attended this meeting, it has been proposed that he should be requested to consider;

1st. Whether the channel of the river could be confined in a straight line from the end of the present causeway to the Lamp Rock it would not have the effect of deepening and scouring the channel from the Lamp Rock to Chester?

2nd. Whether it is practicable to do this, and by what means, and whether any alteration would effect the outlet of the river from the Lamp Rock to the sea?

3rd. Whether he can suggest any other preferable plan for improving the navigation of the river?

That he be requested to make a Report on these several points to this Committee, at a meeting to be held on the last Thursday in March next.

JOHN WILLIAMSON, *Mayor.*

At a Meeting of the River Dee Commissioners held at the Exchange in the city of Chester, on Monday the 30th April, 1821,—

Present:—Thos. EVANS, Esq., Deputy-Mayor; Alderman NEWELL; Alderman Robert BOWERS; Alderman FRANCIS; Alderman Henry BOWERS; Alderman WILLIAMSON; Wm. POWELL, Esq.; Abraham BALL, Esq; Rev. P. W. HAMILTON; Mr. Thomas WHITTLE; Mr. John WILLIAMSON; Mr. Joseph EVANS; Mr. John WHITTLE; Mr. John MELLOR.

The Report of Mr. TELFORD, on the points referred to his consideration by the Commissioners at their meeting on the 20th September last, having been read, it is ordered that a copy thereof be transmitted to the Committee of the River Dee Company, and that they be required to carry the plan suggested by Mr. Telford for the improvement of the channel of the River Dee into execution, with as great expedition as the nature of the work will admit of; and that the Committee be requested to transmit their answer to the clerk of the Commissioners, to be by him laid before them at their next meeting.

Ordered that the meeting be adjourned to the Exchange, in the city of Chester, on Monday the 21st inst., at 12 o'clock at noon, for the purpose of receiving the answer of the said Committee.

THOMAS EVANS, *Deputy-Mayor.*

No. 294.
Report of the Annual Meeting of the River Dee Commissioners, 1845.

No. 294.

[From the Chester Chronicle of August 8th, 1845.]

Report of the Annual Meeting of the River Dee Commissioners.

On Tuesday last, at 12 o'clock, the River Dee Commissioners held their usual annual meeting, under the statute, in the Shire-hall, Chester Castle. There were present—

Hon. E. M. LLOYD MOSTYN, of Mostyn-hall; F. DAVIES COOKE, Esq., of Gwysanog; C. J. W. DEANS DUNDAS, Esq., Aston; R. MASSEY, Esq., Moston; Rev. P. W. HAMILTON, Hoole; R. BRITTAIN, Esq., Hoole; Rev. H. JONES, Northop; T. LEWIS, Esq., Highfield; T. DAVIES, Esq., Chester; EDW. ROBERTS, Esq., Chester; EDW. BATE, Esq., Kelsterton; T. FRANCIS, Esq., Chester, &c.

The meeting was also attended by HENRY POTTS, Esq., clerk to the Commissioners, and Mr. WEDGE, agent to the River Dee Company.

The Hon. Mr. MOSTYN was voted into the Chair.

Mr. POTTS informed the meeting that the first business was to receive the report of the supervisors as to the soundings of the river. The River Dee Company appointed one supervisor, and the Chester Corporation another; and the statutable depth that the company were required to maintain was 15 feet in all parts of the navigable part of the river in moderate spring tides.

The supervisor of this company attended, but there was no attendance on behalf of the Chester corporation. The former produced his books, by which it appeared that he made soundings of the shallowest parts of the river at low water, and also sounded at the same places at high water in the same tides, and that this was done once a month.

It is necessary here to explain that the standards required to be kept by the company are lost, and consequently "moderate spring tides" can only be ascertained by reference to some other place. Mr. Wedge gave it as his opinion that a tide at Liverpool dock gates, rising 18 feet 6 inches was a moderate spring tide; and consequently when such tides prevail in the Mersey, the River Dee Company ought to maintain 15 feet in the river Dee; and when the soundings do not show that depth, the Company has not complied with the provisions of the statute.

The statute, however, thus designates "a moderate spring tide" in the Dee:—"That in commuting the depth of water in the said river, and in determining all questions relating thereto, the height thereof at a moderate spring tide shall be reckoned and ascertained to be level with the said height of 9 feet above the bottom, floor, or apron of the said ten-gate sluice, as the same is marked on the said pile called the standard." When the water rose to the 9-foot mark, the depth of water in the river ought to have been 15 feet.

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CHESTER.
River Dee.

No. 294.
Report of the Annual Meeting of the River Dee Commissioners.

Mr. POTTS read the soundings from the supervisor's book as follows:—

Date.	Day Tides at Liverpool by Holden's Tables.		Day Tides at Liverpool by Observation.		Chester		Less than the Statutable Depth by Holden's Tables.		Less than the Statutable Depth by Observation.	
1844	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
June 1st. .	18	11	18	1	14	1	1	7	0	9
July 1st .	18	7	18	0½	14	4	1	0	0	5¼
Aug. 1st .	18	8	17	11	13	3	2	2	1	5
Aug. 29th .	18	5	17	6	12	9	2	5	1	6
Sept. 13th .	18	4	18	4	13	11	1	2	1	2
Oct. 14th .	19	10	20	5	13	2	3	5	4	0
Nov. 12th .	20	6	20	1	15	2	2	1	1	8
Dec. 27th .	16	5	16	3	10	9	2	5	2	3
1845										
Jan. 8th .	18	8	18	7	12	7	2	10	2	9
Feb. 6th .	18	7	18	3	12	9	2	7	2	3
March 7th .	18	4	17	5	12	0	3	1	2	2
April 9th .	17	10	19	0	11	9	2	10	4	0
May 29th .	13	5	14	0	11	0	+0	10	+0	3
June 20th .	18	0	17	10	11	7	3	2	3	0
July 19th .	18	7	17	1	11	1	4	3	2	9

[In the 5th and 6th Columns, which we have added, it is assumed that 18 ft. 3 in. is the height of an average spring tide on the Liverpool Dock Gates, as shown by Lieut. Lord, R.N., Marine Surveyor. At the same time there should be 15 feet depth in the River Dee, and consequently the difference between the height of high water at Chester and Liverpool should never exceed 3 ft. 3 in., whereas on the 14th October, 1844, and the 9th April, 1845, by actual observation, it was more than 7 feet.—ED.]

The soundings taken at low water were also read; and it appeared that during the whole of the time they had been exceedingly low. In some instances only a foot and a-half water had been found.

Mr. MOSTYN said he had yesterday been informed that at dead low-water the King's Ferry could not be worked.

Mr. DUNDAS also made an observation to the effect that it could be crossed at the same period of tide by persons on horseback.

Mr. BATE said that boys could now wade over in the navigable part of the river. There was a very general opinion prevailing that the river never was in a worse state than at present.

Mr. DUNDAS drew the attention of the Commissioners to the fact that by the River Dee Acts, the Company were bound to maintain three standards, one of which should be at Wilcox Point. He wished to know why the Act was not complied with?

Mr. WEDGE explained that the standard had been lost above seventy years. By the Act, the foundation of it was from the sole of the ten-gate sluice, which was on the same site as the present sluice at the cheese stage. That datum, however, did not now exist. The River Dee Acts came into operation in 1733, and the Company had then appointed a supervisor, but the Chester corporation of that day neglected to do so. The Company's supervisor, Mr. Griffith, was appointed in 1744, and he held the office until about 1800. Up to that period the Chester corporation had no supervisor—and the only one upon whom they could depend for information was Mr. Griffith. The standard being lost, and there being no statutable data to guide them in replacing it, about 35 years ago he (Mr. Wedge) had done his best to get at some data so as to comply with the Act; and he had availed himself of the experience of Mr. Griffith, who had told him that when the tide rose to nine feet on the old statutable standard, it also rose to the floor of the house he occupied; and from that data he (Mr. Wedge) caused a standard to be erected at the sluice-house, and the line was now in existence. The Commissioners of that day, however, were not satisfied with it; and consequently now there was no standard. He was of opinion that it corresponded with the old statutable standard. He also stated that there could be no doubt that for the last 15 or 16 months the river had been shallower than for some years previously; and that he attributed to the long droughts that had prevailed, which had deprived the river of the usual scouring power.

Mr. POTTS said that one flood from Bala Pool would quite restore the river.

Mr. ED. ROBERTS wished to know whether the River Dee Company had any project in view for restoring and maintaining the channel, as required by the statute.

Mr. WEDGE said that Mr. Telford had been consulted by the Company; and they had acted on his advice, and carried out his suggestions. The latest works were the jetties and groynes. The new stone causeway had been erected on his suggestion. For some years, however, not much had been done. The Company did not levy any tonnage now, nor had they done for some years.

Mr. DUNDAS said that his grandfather had stopped the tonnage because the statutable depth was not maintained.

Mr. BATE expressed an opinion that the last causeway had had the effect of diverting the channel in a wrong direction, and had in fact injured the navigation. The channel now ran into the centre of the estuary, whereas it should be carried towards the Pentre Rock.

Mr. DUNDAS said that Mr. Scott Russell had expressed a similar opinion to Mr. Bate.

Mr. ED. ROBERTS also said that Messrs. Stevensons had recommended that that causeway should be carried on to the Pentre Rock, and Mr. Scott Russell had coincided with him. He wished to know what the Company thought of that plan.

Mr. WEDGE said the Commissioners were mistaken as to the direction of that causeway; it certainly did point towards Pentre Rock, and was intended to divert the channel in that direction.

Mr. ROBERTS then reminded Mr. Wedge that he (Mr. Roberts) and Admiral Dundas had made a survey of works, and particularly of the new causeway; he wished to know whether that causeway had been carried any further since that time?

Mr. WEDGE again said that not much had been done of late years. No extension had been made of the causeway since the time of which Mr. Roberts spoke.

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No. 294.
Report of the Annual Meeting of the River Dee Commissioners, 1845.

Mr. DUNDAS then drew the attention of the Commissioners to the fact that the River Dee Acts required that the Company should maintain two additional standards, in order to guard against the decay or removal of the standard at the ten-gate lnice. That duty the Company had evaded.

Mr. WEDGE said there never was but one standard, and that was lost before his time, and no one could give any better data than he had suggested. He was of opinion that one standard at the upper end was all that was required.

Mr. BRITTAIN said it was desirable that standard should be restored forthwith, or the Commissioners and the Company might lose the benefit of Mr. Wedge's information and experience.

Very considerable conversation ensued as to the most advisable course for the Commissioners to adopt. It was deemed necessary that the River Dee Company should be reminded of their duties, and also that the standard should be restored.

A resolution was passed to the effect, that as it appeared from the supervisor's soundings that for the last year the depth of the river had been two feet or more less than the statutable depth, and that the Commissioners called upon the River Dee Company to restore the channel forthwith; which resolution was adopted unanimously.

Mr. ED. ROBERTS moved, and Mr. DUNDAS seconded, that a committee be appointed, consisting of the Commissioners then present, with power to add to their number, and three to be a quorum, to report upon the practicability of restoring the statutable standard; and it was directed that the committee should have their first meeting on Tuesday, the 19th inst., at 12 o'clock at noon, at Chester Exchange, which resolution was unanimously adopted.

Mr. DAVIES COOKE drew the attention of the Commissioners to the defective boats for the use of horses kept at the higher ferry; and a resolution was passed, calling upon the River Dee Company to maintain that ferry in a better state of efficiency.

The Commissioners then adjourned their meeting to the first Tuesday in November, to be held at 12 o'clock at noon, at the Exchange, in the city of Chester.

No. 295.
Correspondence relative to the River Dee.

No. 295.

River Dee Office, 9, *Mansion-House Street*,
9th January, 1846.

SIR,

By direction of the Committee of the River Dee Company, I beg herewith to transmit you, for the information of the Tidal Harbours Commissioners, a copy of a letter from Mr. Thomas Wedge, the Company's agent at Chester, referring to, and in further explanation of, a letter from the chairman of this Company to Captain Washington, dated the 24th November last, on the subject of the navigation of the River Dee.

I am also desired by the Committee to state, that they take the liberty of sending this document, under the impression that the remarks and information which it contains may be of service to the Commissioners of Tidal Harbours when their Report to Her Majesty's Government is under consideration.

I am also directed to enclose herewith, for the information of the Tidal Harbours Commissioners, the accompanying copy of the latest report which the Committee have received from their agent of the depth of water in the river. The Report is dated the 29th ultimo.

I have, &c.,
B. LYON, *Secretary*.

To the Secretary of the Tidal Harbours Commission.

Soundings in the River Dee, taken by the appointed Supervisors, 29th December, 1845.

	Low Water. ft.	in.	At High Water. ft.	in.
Opposite Johnson's Hatch	9	0		
Morgan's Field	8	6		
Poplar Tree	7	0		
Plantation	7	6		
Mill Rails	5	0		
Groyne below Mill Rails	4	8		
Mill	7	0		
Ferry Garden	7	6		
Groyne below Ferry	4	6	16	2
Spie Hall	5	6		

	ft.	in.
Depth at high water, shallowest part	16	2
,, Liverpool Dock Gates (from Holden's Tide Tables)	19	0
,, as *observed* on that day (*see below*)	19	4

Rise of the tide on the standard, $2\frac{1}{2}$ inches under the mark of 9 feet.

[Judging from this single observation, it would appear that the 9 feet mark on the standard corresponds to the level of $19 \cdot 6\frac{1}{2}$ on the Liverpool Dock Gates; now $18 \cdot 3$ is the height of an average spring tide, therefore the Standard is set $1 \cdot 3\frac{1}{2}$ too high.—ED.] (*See also* No. 296.)

Lieut. LORD, R.N., *on the Height of the Tide at Liverpool, on the 29th December*, 1845.

SIR,
Marine Surveyor's Office, Liverpool, March 26th, 1846.

The height of high water at Liverpool on the 29th and 30th December last was as follows, viz.:

	h.	m.	ft.	in.	
Dec. 29, Morning	11	12	19	4	Datum Old Dock Sill.
,, Evening	11	35	20	1	
Dec. 30, Morning	11	58	21	8	

The heights taken from Holden's Liverpool tide tables are as follows:—

	ft.	in.
Dec. 29	19	0
,, 30	20	3

The level of average high-water mark of spring tides is 18 ft. 3 in. above datum. Westerly gales

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cause our highest tides. It commenced blowing freshly from the S.W., at noon, on the 29th December, accompanied with a very heavy swell; gradually increased to a heavy gale at W. on noon of the 30th, and ended with moderate breezes from N.W. to W.N.W. at midnight of the 30th.

Yours, &c.,
WM. LORD.

Capt. Washington, R.N.
&c. &c.

No. 295.
Correspondence relative to the River Dee.

River Dee Office, 9, *Mansion-House Street*,
13th January, 1846.

SIR,

I have the honour to acknowledge the receipt of your letter of the 10th instant, and agreeably to your desire, I take the earliest opportunity of herewith sending a map of the Company's property at Chester, showing the estuary of the river, and the embankments formed by the Company at various periods down to the present time, which is probably the document that Mr. Wedge promised to send to the Commission.

I have, &c.,
B. LYON, *Secretary.*

To the Secretary of the Tidal Harbours Commission.

River Dee Office, *27th February*, 1846.

SIR,

By direction of the Committee of this Company, I herewith send you copies of all the Reports and other documents referring to the navigation of the River Dee alluded to in your letter of the 29th ult., as well as a printed copy of this Company's Acts of Parliament.

I have, &c.,
B. LYON, *Secretary.*

To the Secretary of the Tidal Harbours Commission.

Casualties in the River Dee in 1844-45.

27th Dec., 1844.—The *Trader*, drawing 9 ft. 3 in., in a tide which, by Holden's tide table, rose to 16 ft. 5 in., grounded 200 yards below the Sluice-house. Wind, easterly.

12th March, 1845.—Height of tide by table, 17 ft. 5 in. *Trader*, drawing 8 ft. 5 in., could not start.

25th May, 1845.—Height by Holden's tide table, 18 ft. 6 in. *Trader*, drawing 10 ft. 1 in., grounded; took 14 tons out, and got her off in the night's tide.

5th June, 1845.—The *Glynne*, draft 9 ft; tide table 15 ft. 4 in.; ship grounded. 6th June.—Still aground. 7th.—Got *Glynne* off, and to the crane; tide table 15 ft. 6 in.

THOMAS EVANS,
Agent to the Shipping Company.

P.S.—14th Jan. 1846.— The *Cheshire Lass* left the Sluice-house, drawing 11 ft. 2 in., restricted by the pilot to 11 ft.; tide rose 17 ft. at Liverpool. The remainder of her cargo was sent down in a steamer, part taken on board at Connah's quay, 5 miles below Chester, and part in Wild Road, 13 miles below the city. The freshes continue good, and the channel better than for 4 years before.

No. 296.
Comparison of Actual Observations on the Tides at Liverpool and Chester.

No. 296.

Comparison of actual Observations on the Tides at Liverpool Dock Gates, and at the Dee Company's Standard at Chester, for Twelve Days.

An average spring tide reaches 18 feet 3 inches above datum, the Old Dock sill, on the Liverpool Dock Gates.]

Date.	Moon's Age at Noon.	Time of Day High Water at Liverpool.	Height of High Water at Liverpool Dock Gates.		High Water below the Level of an average Spring Tide.	Height of High Water on Dee Standard.	Height of an average Spring Tide on Standard.	Nine-foot Mark on Standard too high.	Remarks: Wind, Weather.
			By Holden's Tide Tables.	By actual Observation.					
1846.		H. M.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	
June 22	28	10 17	15 2	15 8	2 7	4 7½	7 2½	1 9½	S.S.W. Fresh breezes, with rain.
„ 23	●	11 0	15 7	16 10	1 5	6 8	8 2	0 10	N.W. Strong gales and squally. A forced tide.
„ 24	1	11 36	16 1	16 10	1 5	6 3½	7 8½	1 3½	N.W. Moderate.
„ 25	2	0 12	16 3	16 8	1 7	5 11	7 6	1 6	W.N.W. Light winds.
„ 26	3	0 47	15 11	16 3	2 0	5 4	7 4	1 8	S.S.W. Moderate, with rain.
„ 27	4	1 26	15 7	16 1	2 2	5 2	7 4	1 8	S.W. Light winds and rain.
„ 28	5	1 59	15 2	15 4	2 11	4 2	7 1	1 11	W.N.W. Fresh breezes.
July 8	○	10 27	16 10	17 1	1 2	5 11	7 1	1 11	S.E. Moderate.
„ 9	15·8	11 14	18 1	17 9	0 6	7 2	7 8	1 4	S.E. „
„ 10	16·8	0 1	19 3	18 1	0 2	7 8	7 10	1 2	Nly. „
„ 11	17·8	0 46	19 6	18 6	0 3	7 10	7 7	1 5	N.N.W. „
„ 12	18·8	1 33	19 3	18 1	0 2	7 6	7 8	1 4	N.Nly. „
„ 13	19·8	2 20	18 7	17 1	1 2	6 6	7 8	1 4	S.Wly. „
„ 14	20·8	3 11	17 5	16 1	2 2	5 7	7 9	1 3	Wly. „

The observations at Liverpool were made under directions of Lieutenant Lord, R.N., marine surveyor, and at Chester, by Mr. Cockburn Curtis, C.E., and Robert Kelly, Master Mariner.

The mean of these observations would place the Dee Company's Standard 17¼ inches too high; but there are indications of its being nearly 2 feet above its proper level. And this, for the first time, explains the anomaly that has long been noticed by the citizens of Chester, that while there was apparently something near the statutable depth of water in the river, according to the supervisor's soundings and the standard, yet no pilot would take charge of a vessel drawing more than 11 feet.

No. 296.
Brooks, on forming New Docks at Tynemouth.

No. 296

NEWCASTLE—RIVER TYNE.

Second Report by W. A. Brooks, Esq., C.E., *on the Improvement of the Tyne, and proposing New Docks at Tynemouth.*

Sir, *Guildhall, Newcastle-on-Tyne, 9th, October,* 1845.

I have to request the honour of your attention to the accompanying plan which has delineated on it a portion of my views for the improvement of the River Tyne and for affording increased accommodation to the shipping of the port. It is possible that your Committee may deem it advisable to call the attention of the Council to the subject at the present time, seeing that strenuous exertions are being made to draw or divert to other ports a large portion of that trade which may be considered as legitimately due to the port of Newcastle from its superiority as a harbour, and the facilities offered to commerce by the immense marine belonging to it, the latter causing Newcastle to rank as the second port of Great Britain in this respect. The Tyne, as will be seen by the chart accompanying this Report, not only at present possesses long ranges of deep water berths adequate for fleets of several hundred vessels, but likewise possesses in itself elements for affording almost any probable amount of increased accommodation which may be required, by the formation of docks, in the well adapted natural tidal receptacles of Jarrow Slake and Coble Dean, and also in the spacious area exposed at low water between the low light and the Spanish Battery at Tynemouth. It is, however, to this latter site that I wish, as engineer to the Corporation, to be enabled to draw your serious attention, as the course of execution of docks, at this place would place at disposal abundant materials for effecting an important improvement at the mouth of the harbour by the formation of a pier on the north side running directly eastward from the rocks under the Spanish Battery.

Of the great natural facilities offered for constructing docks either on the east or west side of Jarrow Slake little need be said, as the advantages thereof are generally acknowledged, and the execution of a spacious dock in this locality is necessary, not only to afford accommodation to the present trade but to that which by the recent improved railway-communication will be drawn to it from the district west and south-west of the Wear.

Should difficulties arise as to the execution of the excellent dock on the east side of the Jarrow Slake, for which an Act of Parliament has been already obtained, it will be seen that the western side of the Slake will, by the plan of docks suggested by me, afford accommodation ample for the shipment of almost any quantity of coal from the south-west coal-field of Durham, as well as for that which now finds its way to the Tyne as the nearest and best port.

The northern boundary or quay of these projected docks will also assist to carry into effect the views proposed by me to the Council for the improvement of Jarrow Reach. On the same plan I have delineated my conceptions as to the arrangements which should be adopted in the construction of docks at Coble Dean should the excellent deep water shipping-place at Hayhole be found insufficient to supply the trade carried on in that vicinity.

On the bar of the Tyne there is usually to be found at low water spring-tides, a depth of from 8 to 9 feet, and the flow is from 15 to 16 feet in ordinary spring-tides, and 18 feet with strong winds from north or north-west, the depth on the bar at high water ranging between 23 and 25 feet; during neap-tides the depth is about 5 feet less.

Taking into calculation the great draught of a large proportion of the marine of this port, an enormous advantage would accrue were they enabled to sail irrespective of the period of spring-tides, or of that diminution of the depth which is created by the scend of the sea, which almost always makes the available depth less by 2 or 3 feet than in a perfectly calm sea; hence the importance of adding to the present depth on the bar, which I consider to be practicable for the following reasons.

A close survey of the mouth of the Tyne shows that a diminution of the power of the ebbing waters to maintain a deeper channel over the bar, has taken place from two causes, which are capable of being removed by the plan propounded by me.

The first arises from the discharge taking place over too wide a surface. Thus all will readily admit that the great body of the tide which ebbs out over the rocks under the Spanish Battery north of the main channel, being a width of 500 feet, must diminish the useful effect which it would produce if discharged with the remaining volume through the main channel, where the bed consists of sand.

The second cause of diminution of depth in the main channel arises from the existence of another channel, which usually has about a foot less water through it; a small bank of sand dividing the two channels.

The direction of the ebbing waters being to the north, it must be evident that a very great portion is uselessly expended in its passage over the Black Middens and rocks under the Spanish Battery; which latter rocks form in truth part of the bed of the embouchure of the Tyne, and it is for the purpose of preventing this loss of useful power that I have planned a northern pier commencing or abutting against the cliff at the Spanish Battery, and extending across the rocks in a southerly direction for 500 feet, then pursuing an easterly course for 1600 feet, as per plan, and terminating seaward in 15 feet depth at low water of spring-tides.

The construction of this pier must concentrate the energy of the ebb-tide upon the bed of the main channel, and effectually remove any bar or deposit from its present position. Whatever bar may remain will be forced farther out to sea, or into deeper water, where it will be exposed to the influence of a stronger passing current. There is a natural depth or condition of the bar of a river which is due to the volume of backwaters it possesses, and the manner in which the discharge of the same is affected by the presence of inner bars or shoals, but it is clear that the state of this sectional area on the bar may be materially reduced as to available depth of water by any enlargement of the width of the channel, or mouth, or division of the main channel into several smaller ones. The depth over the bar of the Tyne, which the natural power of its ebbing waters is capable of maintaining, is at present reduced by the dispersion of the current over too great a width.

The concentration of the useful effect of the ebb-tide on the bar can only be produced by the construction of a pier on the north side of the river as proposed by me.

For this purpose a pier on the south side, as proposed by the late Mr. Rennie would be useless, because the course or inclination of the current of the ebb is not at all in that direction.

During the ebb the sands on the south side are in an eddy tide, or in comparatively slack water, and a deposit then takes place of that vast quantity of sand which is swept from off it by every previous

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flood-tide, a large portion of which latter has its natural passage into the Tyne over the Herd sand. The operation of the flood-tide, or its scouring effect upon the Herd sand is well known; but it does not follow as a matter of course, as is imagined by many, that any diminutions of the depth of the navigable channel above takes place from this cause: my own opinion is, that the depth is not reduced by such sand being carried up the river, because it is quite clear that the whole is returned on the ebb, and either redeposited on the Herd or carried out to sea

If this were not the case the main channel to sea would be through "the wheel." If this were not the case the Tyne would have been choaked up many ages ago.

The power of the ebb to return to sea the sand brought in by the flood is greater than the power of the latter to accumulate it within the river, hence the main channel is alway to be found in the direction of the strength of the ebb. Some persons imagine that the power of the flood-tide to move sands is greater then that of the ebb, because they observe some sands which, alive on the flood-tide, are found hard on the ebb-tide; but they do not carry their observation a little further, which, if they did, would compel them to conclude that the cause of the firmness during the ebb is that these sands happen to be out of the direction which the current of the ebb takes, and are solely exposed to the strength of the flood-tides, such as the Droitwich sands and the Herd sand, which are all hard on the ebb, and alive on the flood. It is also erroneous to conclude that the ebb is greater in power than the flood-tide, because the duration of the ebb-tide in some rivers, is found to be considerably greater than that of the flood-tide. Its preponderative power arises from other causes; the fact is, that it is that very excess of duration which diminishes the power of the ebb. My readers will agree with me, that the same volume of water must be more effective if discharged in six hours than in seven: if discharged in six hours or during the natural period of the ebb, there can be no confliction with the flood-tide; but when the discharge is extended over a period of seven hours, the last of the seven must be during the period of the first hour of the flood-tide, with which the discharge must be in opposition and attended with injurious consequences. I have in my investigations into the state of rivers invariably found the greater the period of the discharge of the ebb exceeds the period of the upward or flood current, so much worse is found to be the state of their bars.

If a pier were made over the whole of the length of the Herd sand, it would not prevent the entrance of sand into the Tyne, because the flood would still derive an abundant supply from the sandy bed of the sea, without the bar to the eastward.

The pier on the Herd sand, as planned by the late Mr. Rennie, would (if constructed) have the affect of forcing heavy seas up the river during gales from the east and north.

Aware of the range of sea which would attend the formation of a continuous line of pier from the bar to the narrows, I have proposed effectual means to check the inroad upon the tranquillity of the port, which such a construction would produce: the north pier is therefore made to abutt or commence against the cliff under the Spanish Battery, and an area of 18 acres is left to the westward, or between it and the proposed Docks.

This space of 18 acres will be found of sufficient extent to allow all waves to subside within it after passing over the bar.

Another cause of tranquillization will be found in the deepening of the present channel which will result from the inclosure of the area occupied by the docks and western tidal basin. It will be observed from the accompanying chart, that the soundings rapidly increase in depth outwards, from the point fixed by me as the extremity of the north pier; thus at 40 fathoms' distance the depth is 21 feet, and at 80 fathoms' there is a depth of 24 feet, at low water of spring-tides.

Vessels running for the harbour in heavy gales from the north-east, will therefore be in grey water, until almost close to the pier end, which they may boldly steer for, and immediately find themselves in shelter.

From the security which will be afforded by the north pier no future casualties need occur on the Herd sand, on which vessels are now occasionally lost, owing to their anxiety to give a wide berth to the rocks under the Spanish Battery. While the approach to the port is thus rendered more safe it must also be manifest that, by the protection of the north pier, vessels will be able to clear out to sea under circumstances which would be impracticable in the present state of the entrance.

From the long attention which I have given to the subject of refuge harbours, I doubt not the increased safety to mariners navigating the north-east coast which would be afforded by the construction of this pier at the mouth of the Tyne, would be hailed as one of the greatest boons that could be conferred upon them.

The large space between the tidal basin and the low lighthouse, I have proposed to convert into a dock for colliers, having an area of 31 acres, but divided into three parts by two quays, each of 200 feet in width on which staiths and sidings will be constructed.

These docks will have a connection with the eastern tidal basin by means of double gates, which will be available in smooth weather, or during off-shore winds; at other times the communication will be solely by means of the western gates opening into a tidal basin of 8 acres, formed partly out of the muscle scalp, and partly out of the low spit of land on which Clifford Fort is situated.

Vessels running for the docks in tempestuous weather will stand on until abreast of the low light, and then bearing up to the northward, enter the slack on the west side of the low light, and thus reach the western tidal basin and docks in still water from whatever quarter the gale may be blowing at the time.

The formation of the docks will be a matter of extraordinary easy execution in comparison to the heavy expenditure usually incurred on such works.

The whole of the works for the docks being situated on a base of rock and hard clay, which bares at low water of spring-tides, will be inclosed in the first instance by outer walls forming part of the intended quays, and the docks subsequently excavated to a depth of 10 feet below low water, so as to allow vessels of the largest draught to lie afloat during neap-tides. The docks (exclusive of the tidal basin) will afford accommodation to above 300 large ships, and quay berths for above 50 ships to, at one time, take in cargoes.

The expenditure which will be incurred will be under 250,000*l.*, and the advantages which will be received in return may thus be shortly summed up.

1st. Greater depth of water on the bar.

2nd. Increased security on arrival at, and departure from, the port.

3rd. The power of getting to sea under circumstances from which vessels are now unable to avail themselves of.

4th. Increased safety within the port by the withdrawal of a large portion of the shipping which

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now frequently crowd the pool between North and South Shields, in which occasionally from 700 to 800 ships are moored.

5th. An immense increase of accommodation to the trade of the port and the certainty of drawing to it a superior class of vessels, which will not venture to take in their cargoes unless sure of being able to do so afloat at all times. It is obvious that facilities exist for the formation of docks upon a smaller scale and consequent diminished expenditure; but I see no reason to doubt the whole being required, and proving ultimately highly remunerative as well as useful.

I am, &c.,
WM. ALEX. BROOKS.

To the Chairman of the River Committee.

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River Wear.

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Abstract of Labelye's Report on the Harbour.

No. 298.

SUNDERLAND—RIVER WEAR.

Abstract of MR. CHARLES LABELYE's *Report on the Improvement of the River Wear and Port of Sunderland.*

July, 1748.

THE Wear forms itself into a natural basin over against Sunderland, which is contracted in breadth, and consequently deepened, before it comes against the custom-house; which breadth is and will be still further lessened by the tides continuing to wash the ballast-heaps down into the river, till a proper stop be put to the growing evil. From hence the current passes in a pretty straight direction towards the sea, widening gradually, and the depth decreasing, till it comes at the Stell and Stell canch, which I call the inner bar, and which is more prejudicial to navigation than the outer bar. From this inner to the outer bar, the water divides itself into several branches, but chiefly runs in two channels, the one passing by the two beacons, the other nearer to the south pier, on the inside of which pier, as well as on the outside, a considerable quantity of sand has been lately gathered.

The mouth of the river is considerably embayed, by the eastward projection of the coast on both sides, and the tides set into the harbour from all the parts of the bay, but most from the south-east point.

The goodness of both the river and harbour is greatly impared by many injurious circumstances and prejudices; the principal of which that I shall observe are—

1st. Several shoals and banks of sand, which interrupt the navigation of the keels down the river; two of which, esteemed to be the worst, are Forster's and Cyngden Sands.

2nd. The harbour is much injured by the rubbish, filth, and mud which fall into the river from the town.

3rd. By the increasing contraction of the river nearly opposite to the Custom-house; which, if suffered to proceed, will be the utter ruin of the haven, and also greatly endanger the wharfs and buildings adjoining.

4th. The next prejudice is the Stell, which consists of a bed of gravel and sand, with some larger beach stones, and is so shallow that a ship drawing nine or ten feet of water cannot safely pass over it.

5th. The water of the Stell dividing itself into many channels or streams.

6th. The great danger which the shipping is exposed to in the harbour by tempestuous seas, when violent winds blow from the N.E. or E.

7th. Ballast cast in the road, which the flood-tides drive into the river, and thereby increase the prejudice of other sands.

To prevent the river and haven from growing worse, to remedy in a great measure the prejudices, and to improve the harbour and river, the following proposals are made, and here laid down in the same order that they are advised to be performed:—

First, that the river above the town be cleared of sands and shoals, which obstruct the navigation of the keels, particularly at Foster's and Cyngden Sands; the means and methods of doing which are very obvious, viz.: by contracting the channel at those places where the obstructions are, and a little way above them, that the increased velocity of the stream may scour them away: in order to which I propose one-fourth of the present water-way to be taken in, by proper stone wharfs and jetties, particularly—

At Cyngden Sands, I advise that the present jetty be repaired, and joined to the north shore at both its extremeties, and then backed with earth or sand.

At Foster's Sand the river to be considerably contracted with stone wharfs, accordingly as I have marked with strong red lines on Mr. Thompson's plan, where I think the face of these wharfs should be placed. I advise to begin by wharfing from the east side of North Biddick Burn, to the east end of the said sand, and then try what one winter will do towards scouring away the obstructions; which if not found effectual, they must be taken up by dint of labour, or the river must be contracted all the way to the elbow next below, by a wall, whose front I have also marked in the said plan by a row of red dots; after which, at convenient times, the sands may be easily taken up, and thrown behind the said walls, in order to deepen the channel a foot or two at low water. In some places I think it advisable to harrow the bed of the river, especially at the latter end of summer, so that the sands and other soils may be more readily washed away by land-floods. If all these remedies prove ineffectual ballast-engines must be set to work, as on the river Thames.

In relation to the harbour, I advise against ever encroaching upon the basin, or taking any part of it in by wharfing; because it will deprive you of a useful stock of back-water. But,

2ndly. The next work to be done is to provide a remedy against the choaking up of the river, nearly opposite to the Custom-house, by the sands being continually swept into it from the ballast hills, &c., to effectuate which, I recommend wharfing in that part of the river and the Ham Sand; and, after leaving a proper landing-place for the ferry-boat as may be seen in the draughts, I propose the said wharf should begin there, and thence run nearly in a parallel direction to the opposite wharfs on the south side of the river, and be continued down to the Stell, and no further for the present. The sands already lodged in the river, I propose to be taken up and cast behind this north wharf, all along to the foot of it.

3rdly. The next thing of importance is to take up the Stell, which no conjoint force of tides and land floods is able to remove. It should be deepened two or three feet from the surface, which must be done by art and labour.

4thly. The better to cover the haven, and secure the ships from being endangered by great seas and

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violent winds setting right up the harbour, I propose a north pier, which will greatly contribute to it; though at this place it is not practicable to shelter the ships in the haven entirely from all winds. The length, shape, and position of the north pier which I recommend will be best explained by the draughts annexed. I propose the head of this pier to be placed exactly north (by the Compass) of the south pier: because, 1st, such is the setting of the tides; 2ndly, if the said head were placed eastward, it would stop part of the flood and ebb, and soon gather vast quantities of sand within it; and if it stood to the westward, it would not shelter the haven so well; 3rdly, the position recommended agrees with the experience and practice of all good engineers. I propose that it should not advance farther from the north Highlands than is represented in the draughts: 1st, because I think it proper to leave an interval of about 200 yards, lest the entrance of the haven should be made too difficult in rough weather, and I propose to contract the current, a little way farther up, into about 100 yards in breadth, which is the usual breadth allowed to most entrances of this kind; 2ndly, because the so placing the north pier will moderate the expense; lastly, I propose it to bend inward; because it will be stronger to resist the violence of the seas than if quite straight, though there is much less in the shape of piers than some people imagine. I propose the north pier to be built full as high all the way as the south pier-and to have a parapet wall on the east side, with merlons, embrasures, and a stone platform for cannon, also mooring-posts, crabs, or capsterns, and blocks. I think it need not be quite so broad as the the south pier, 20 or 25 feet at the top will be sufficient; but I would have it to batter full one-sixth of its height, or two inches in every foot, likewise strengthened on the outside by a continued breakwater, berm, or foreland, made of large pebbles. After all, as no man can foresee all the consequences that may attend the erecting of a north pier, if it should happen to occasion visibly (which I hope it will not) a greater obstruction to navigation than it removes, it must be unbuilt and taken up.

5thly. I propose that the several channels, now separated at the Stell, be in the next place reduced into one, by wharfing it into a convenient breadth all along from the town to the pier-heads; for, so long as two channels remain, neither of them can be so deep as is requisite, but when brought together, and so confined, will jointly with the basin form a commodious haven, commonly called a long harbour, of which sort most of the good ones in Europe are found to be. What is here proposed may be effected two ways, and accordingly I have annexed two draughts: the first, edged with red silk, where the haven is reduced into the south channel; the second, edged with blue silk, where it is contracted into the north channel. Each of these schemes has its peculiar advantages and disadvantages. If the south channel only be preserved, the current will set in a much straighter direction, and consequently the ebbing tides and freshes will have a greater effect in scouring and deepening the channel; it will also require less time and expense, the south side being already built, and the wharfing on the north side will be the only new work required from the end of the wall at the Stell (already advised to be built) down to the north pier head as described in the draught edged with red silk. But in this case the shipping will not be quite so well sheltered as by the other scheme, viz.: if the north channel only be made use of, as in the draught edged with blue silk, the shipping will be better sheltered; but the course of the river being more crooked, the ebbs and land floods will have less force to scour and deepen the channel than in the first scheme, and the time and expense to put it into execution will be considerably greater; not only because the north channel must be wharfed on both sides from the Stell to the pier-heads, but also the south pier must be lengthened in a sweep towards the north-west, as expressed in the draught edged with blue. By comparing the two draughts together it will be seen that the north wall, as far as the Stell, is equally subservient to both schemes, and therefore that work is the more necessary to be begun very soon; and after it is finished, and well backed with sand, and the north pier is also built, suspend the further works two or three years, and observe the effects on the course, setting, strength, and duration of the tides, and also as to gathering sands on both sides of the north pier; after which I apprehend, the river itself will point out which of the channels ought be preserved: the deepest must be chosen, and I doubt not but it will prove to be the south channel.

6thly. As to the outer bar, it will always remain, and perhaps increase, unless some means can be used to remove it farther into the sea, or at least to lower its surface, and so deepen the water over it. I would advise to have it taken up in calm weather with ballast-engines, so as to make a sideway or passage through it, which ships may be easily directed into by means of beacons or lighthouses. A query may probably be made here, whether it would not be advisable to continue both piers quite down to the bar, at such distance as would confine the ebb-tides and freshes within a proper channel, so as to remove and force away the obstruction, and cast the bar farther out? To this I answer, it would be a work of very great expense, and the removal of the bar thereby would be most uncertain and precarious, for the action of the tides would still bring sand and ballast from the road; and the river, upon falling into the open sea, would immediately lose its velocity, and thereby drop the sand and silt brought along with it, which together, would, in all probability, form a new bar at a very inconsiderable distance from the old one.

In case any one should doubt, that confining the haven within one channel might restrain the tides from flowing as freely into the harbour, and as far up the river as they now do, it will be proper to observe, that fluids do not act or press in proportion to their quantities, or the surfaces on which they stand, but according to their perpendicular altitudes only, so that the height to which the water rises in the harbour, and up the river, depending upon the height it rises to in the offing, the same thing will happen whether the harbour be contracted or not.

Before the conclusion of this Report, one caution more is thought necessary, which is, that the Commissioners may never hearken to any proposal for erecting sluices or locks across the river in any place which the tide reaches; for, let the pretences of such works be run so specious, and the reasons for them run so plausible, be assured that the infallible consequence of all such projects would be the utter ruin of the harbour and its navigation in a few years.

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Smeaton's Report on the Harbour.

No. 299.

Mr. J. SMEATON'S *Report on* Mr. SHOUT'S *proposed Improvements of the Port of Sunderland.*

Gateshead, 16*th January*, 1780.

Having carefully viewed the harbour and piers of Sunderland, and received the information of several eminent masters of ships belonging to that port; having also considered the plan produced to me by Mr. Shout, their engineer, for the improvement of the said harbour; I am of opinion as follows:—

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1. That nothing appears to me so likely to improve the depth of water over the bar (which is unanimously represented as the most desirable circumstance wanting towards its improvement) as the prolonging of the old pier to the low-water mark at the least; and as the direction of the last stretch of the old pier has been now proved, by many years' experience, to afford a sufficiency of shelter to the shipping from outwinds and seas and also to lie in a commodious direction for going in and out, I am of opinion that what has been shown by experience to be right, ought not to be essentially altered; that is, that the head of the advanced pier should be in the line of direction of the present pier

2. That as a considerable part of the old pier from the head inwards appears shaken and its foundation sapped, I see no more easy or proper mode of repair, than that of re-erecting it on a new foundation; and as by doing this, according to the plan exhibited by Mr. Shout, a projecting part of the pier will be taken off, that now appears to disturb the current of the river and break its force in time of great land-floods, which are the principal agents towards scouring the channel, and keeping down the bar, the current of the river will thereby have a more direct course to sea, and being preserved in one direction by the pier from spreading, will not only make a deeper channel alongside the pier, but acting more directly and immediately upon the bar, deepen the channel over it in like proportion.

3. I therefore approve of the plan of Mr. Shout, but look upon it that it will be an improvement to the safety and shelter of vessels within the head; that instead of carrying it out from the point *F*, in a direction parallel to the terminating direction of the old pier, gradually to bring the new pier round, so that its terminating head may be in the same individual place as if the old pier was extended to the same point, as is marked upon the plan by the dotted lines *Ff.*

4. As the new pier is carrying out, the effect of it will be seen; and the degree to which it ought to be extended more certainly judged of; but I am of opinion that it cannot be too far extended, even beyond the bar, if circumstances of time and expense will admit.

5. I apprehend it will be proper to begin the extension of the pier from somewhere near upon a breast of the present old pier head, and to carry it out to some length; suppose that of two years' work, before any part of the old pier is removed; then to work backwards, removing the old pier, as the new one advances towards the point of junction, by which means the shelter to the harbour will be preserved.

6. I am of opinion, that as the extension is carried on, the north sand will follow it, at nearly the same distance as at present, whereon the seas in like manner breaking and spending themselves, will keep the harbour in the same degree of quietude, with the advantages mentioned of a deeper channel over the bar.*

J. SMEATON.

No. 300.
Rennie, on the Improvement of the Harbour.

No. 300.

SIR JOHN RENNIE, *on the Improvement of Sunderland Harbour.*

GENTLEMEN, *London*, 2nd *April*, 1831.

In consequence of the directions communicated to me by your Select Committee, when I was at Sunderland in the beginning of September last, I have carefully considered the most proper plan for proceeding with the works of Sunderland Harbour, both as regards the north and south piers, and I have subsequently had repeated interviews with Mr. Milton upon the subject; I now beg leave to report my opinion as follows:—

The subject may be divided into three parts,—

1st. The exact width and position of the entrance.
2nd. The most advisable part to be now carried into effect, and—
3rd. The most proper form of constructing the piers.

With regard to the first, this is a most important question, and one upon which the greatest deliberation is necessary; because upon a correct decision depends the well-being and preservation of the harbour, and, consequently the whole of the numerous interests connected with the prosperous part of Sunderland and its vicinity.

With this view, the subject has been submitted at various times to the judgment and consideration of those who have been considered most competent to give a correct opinion, among others, Mr. Smeaton, Mr. Jessop, and the late Mr. Rennie, and more particularly the two latter gentlemen, the former of whom reported upon the harbour in 1808, and the latter in 1819. The result of these opinions was that the old piers should be extended, and that the entrance should be of a width not less than 240 feet, having a direction which points further northward. This decision was no doubt occasioned by a careful examinaton and consideration of the tides and soundings, the direction of the currents, and the bearings of the sewers, in order that the grand principles of maintaining and improving the harbour might be obtained by enabling the tidal waters, combined with the floods, to enter and discharge themselves freely into the sea, and in order that the greatest facility of entrance and departure of vessels might be effected.

By a careful examination of the facts recorded in the excellent survey of Mr. Giles made in the year 1819—1820, it will be seen that the direction of the offing and bay currents upon the flood is from north to south and the reverse upon the ebb; and that the in-shore or counter current, which makes the first of the flood about an hour earlier than in the offing, steals along the shore from the north until it reaches the present pier heads, and then, turning nearly at right angles, makes direct up the harbour, and that a considerable time elapses before it obtains its full strength; in consequence, therefore, all vessels desiring to enter the harbour as early as possible upon the flood, if they reach the offing before or at low water, are obliged to come to an anchor, or to lie to, or work backwards and forwards to the northward of the entrance until the flood current makes up the harbour.

The more, therefore, consistently with other objects, that the entrance can be directed towards the north, the more will the facility of entering upon the flood-tide (which is a most important circumstance, particularly during gales to the eastward, when for want of even 15 or 20 minutes, vessels may be driven

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* The old pier as it is removed must be as entirely eradicated as possible, that nothing of wood or stones may be left, to prevent land floods from deepening the channel, in the ground upon which the old pier now stands.

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ashore and wrecked) be obtained; moreover, by the entrance being directed towards the flowing tide, the tidal water would enter and be discharged from the harbour more readily, and consequently the power of preserving itself would be materially increased, which, considering the tendency of it to fill up, ought to be carefully encouraged. Again, upon the ebb-tide it will be seen that, in the first instance, the current tends to the northward—does not attain a complete southerly direction until nearly half-ebb—so that vessels departing from the harbour would run less risk of striking against the north pier, and during winds from the N.N.E. and N.N.W., which check the ebbs, would be enabled to get to sea and clear the south rocks more easily; moreover, by examining the soundings across the bar, it appears that they increase from 18 inches to two feet to the northward, which, particularly where the general depth is so shallow, is an object of the greatest importance; by making, therefore, the entrance more northerly, as proposed by Messrs. Jessop, and the late Mr. Rennie, those important objects of filling and emptying the harbour, and of facilitating the entrance and departure of vessels, ond of obtaining a greater depth of water, would be effected.

The chief arguments, according to the information transmitted to me in favour of preserving the termination of the north pier in its present position, are, that it would prevent the sea from entering, and thus render the interior of the harbour more quiet during easterly gales; and that it would save the expense of pulling down so much of pier as now interferes with the projected alteration in the entrance.

With regard to the first: during gales from the eastward, the entrance might perhaps be a little more exposed; but as the current upon the flood would be more in the direction of the wind than at present, the agitation of the water would not be increased; and upon the ebb, the difference, if any, would not be material.

With regard to the second: in the event of the old line being adopted, it would be necessary to build the new wall in front of the old one, and would be much more liable to be interrupted by vessels striking against it; additional precautions would be necessary to prevent accidents; and the execution of the work, from its confined position, would be much more tedious; the saving, therefore, if any (which I much doubt), in the additional quantity of stone required for the pier in the new line, would be so trifling as scarcely to deserve consideration. The only argument in favour of the old line which appears of any importance, is that from long usage the pilots, and seamen have become accustomed to the direction of the old pier and are prepared to meet its defects, whereas although an alteration might be beneficial, it would be some time before custom could reconcile them to it. I am of opinion, therefore, from all the important arguments above adduced, which I have no doubt, guided by the opinions of Mr. Jessop and the late Mr. Rennie, are so conclusive in favour of the alteration, that I beg to recommend it to your adoption; at the same time if you are of a different opinion, the old line can be adopted without apprehending serious consequences, although the advantage resulting from it will certainly not be so great as the other. With regard to the width of the entrance, however, this in any case ought not to be less than 240 feet.

With regard to the second question:—the south pier having been advanced 100 feet beyond the old pier, it may be left for the present, and as the old north pier is in a very defective state, and if any accident should occur to it, which is not improbable, the consequence to the harbour might be very disastrous; the sooner, therefore, that measures are taken to rebuild it the better, commencing in the first instance at H., marked upon the plan, and extending it outwards until it reaches the parallel of the south pier, by which means their joint effects upon the harbour will be seen, and it will be in your power to make any improvement, by extending both or either, as may be suggested by the nature of the existing circumstances.

With regard to the third: whatever plan be adopted, it is quite clear that it ought to be executed in the most substantial and effective manner possible. The reverse having hitherto been the case with the old piers is the reason that it now becomes necessary to rebuild them. The mode hitherto adopted by Mr. Milton, of carrying down the foundation of the inner wall of the south pier until a solid base to build upon has been obtained below the deepest part of the channel, is the only safe plan that can be adopted on the north pier also, because, in the event of the harbour entrance becoming deeper, which by the prolongation of the piers may be expected, the foundation would be undermined and the safety of the wall itself endangered. Any measures, therefore, short of carrying down the foundation to the same depth and strata, unless rock be obtained, would be ineffectual and in the end be attended with far greater expense and disappointment; strict attention, therefore, must be paid to this important part of the work. The portion executed on the south pier has no doubt been attended with considerable expense; but the depth of sand to remove previous to arriving at a similar foundation on the north pier is not so great; moreover, the experience of the past will serve to remove many difficulties which appeared in the former; and from the additional advice and various modes of overcoming obstacles, which I have explained to Mr. Milton, I have no doubt that the progress henceforward will be more rapid and economical than hitherto. Upon examining the exterior slope of the south pier, as now executed, I find that it varies from 6 to 7 feet horizontal to 1 foot perpendicular, and it is not improbable that unless measures be taken to secure it in its present position, it may extend further.

Now, as this is more than sufficient, and requires a large additional quantity of stone, I should recommend that for the future an inclination of 4½ to 1 should be adopted; and, in order to prevent it from extending further, there should be a double basement course, composed of as thick and large blocks as can be conveniently obtained, as shown upon the accompanying sections, Nos. 1 and 2, upon drawing No. 3; these blocks should be well bedded about three feet into the solid sand, below the extreme base or toe of the slope, and upon this as an abutment, after the rubble filling shall have had time to consolidate. The exterior surface of the slope should be rough paved by selecting the largest, heaviest, and best adapted rubble blocks from Pallion, or elsewhere, equally good, and setting them at right angles to the face of the slope, taking care to make them break bond well over each other, and to wedge them solidly together, and any interstices that may arise between the larger blocks should be well filled with smaller materials, and if necessary hereafter, the surface may be grouted with lime puzzolane and sharp gravel, well combined together. By adopting the mode above recommended of completing the outer slope, a considerable quantity of material and consequently expense will be saved, and it may be completed earlier; and the necessity of future repairs will be, in a great measure, avoided.

The space of the pier between the inner wall and the parapet should be divided into two parts; one for the purpose of working the warps and different ropes employed in assisting vessels in and out of the harbour, this portion, from the information of Mr. Milton, who states that such is the general opinion of those who are acquainted with the port, need not be above 20 feet wide, which will admit of carts and trucks, carrying ropes, anchors, or other necessaries to pass along the pier when required. Bollards for making ropes fast to will also be wanted, and these should be secured independently of the front

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wall by means of three sufficient wrought-iron bars having large flat stones attached to them, which will secure them in their places as shown upon drawing (if required) No. 4.

These bollards or mooring-posts may be made either of cast-iron, wood, or granite, and should be placed eight or nine feet back from the face of the inner wall, by which means the remainder will be left uninterrupted.

The remaining part of the pier should be raised about two feet, by means of steps, above the other, and adapted entirely for the use of the merchants, ship-owners, pilots, spectators, and all those interested in the trade of the port, which will enable them to ascertain with convenience the arrival and departure of their ships, and make arrangements accordingly.

The whole of this portion of the pier, as well as the other, should be well paved with the largest and hardest blocks of stone well dressed and fitted together, and set with puzzolana moter.

The parapet for the most part may be reduced to five feet in height (as Mr. Milton states that the sea does not come above it), having steps at the base to enable pilots and others to keep a look-out when required; and at proper intervals, recesses should be provided for lamps, not extending above the top of the parapet; these lamps should be lighted with gas, and provided with well-polished reflectors, by which means the whole space between the piers will be thoroughly lighted without misleading the ships at sea, and great convenience be obtained for the entry and departure of vessels during dark nights, and the risk of accidents will be diminished.

The front of the inner wall, on both sides of the harbour, should be provided with fenders at intervals of 15 to 30 feet; these fenders should be composed of oak 12 inches square; let about 3 inches into the wall, and so curved as to be adapted to the batter of the wall; at the top and bottom they should be secured to the wall by means of cast-iron caps or sockets, well dove-tailed and wedged into the masonry, as shown on drawing No. 4. When finished they should be well coated with tar, which will contribute to their preservation. These fenders will be found very useful in preserving the masonry and in preventing injury to vessels, which, in the hurry of entering and departing in gales of wind, may be driven against the piers. Mooring-rings have also been found extremely convenient in similar situations. I have represented them on drawing No. 4: they should be fixed to old anchors of sufficient dimensions, which should be carried completely through the walls and counterforts, and then secured in the most effective manner possible.

With regard to landing-stairs, these are generally considered extremely useful, and in consequence I referred to Mr. Milton as to the practice at Sunderland in this respect: he stated, that steps cut in the walls, with iron-rods attached to them, were generally preferred, as being more out of the way, and not liable to be interfered with. I still think, however, one or more flights of steps would be found as convenient here as elsewhere, particularly in cases of accidents, or in sending boats to and from the shore, the distance from one end of the pier to the other being upwards of 1500 feet. I have accordingly marked one set upon the drawing, although they can be omitted if found unnecessary, and I have described them to be constructed in the most durable manner, each step being composed of a single stone, set at right angles to the general inclination of the whole flight, and well dowelled to each other, so as to prevent the possibility of injury. They should be composed of stone of the best description, because they are most subject to wear and tear; and for this purpose I should strongly recommend granite; the difference of expense, compared to its durability over freestone, gives it decidedly the advantage in economy.

One or two large capstans will be found useful, and spaces should be reserved for them, and they can be erected hereafter as circumstances may require.

I am not aware that any cranes will be wanted in this part of the harbour, because I understand, except in extreme cases, the piers are not used for loading or unloading, but chiefly for the transit and guidance of vessels into the interior of the port. It will be proper, however, to look forward to this in the event of any being wanted, and to select stations accordingly.

With regard to cross jetties (as described upon the plan of the late Mr. Rennie) near the pier-heads, the object of these is to tranquillize the interior of the harbour, by giving a greater space within for the waves to expand themselves. The execution of them may be deferred until circumstances should render them necessary.

It may perhaps be needless to observe that every preparation as to obtaining a large supply of stone and everything else that may be necessary to carry on and complete the work should be made before the commencement, and when once begun, it should be pushed forward with every possible vigour during the season.

Having now, I trust, fully commented upon every point connected with the piers which you have referred to me, and having given every explanation as to the future conduct of the works to Mr. Milton, whose zeal and diligence in the service are entitled to every credit, I beg leave to close this Report, at the same time I shall be most happy to furnish any other details or explanations that may appear desirabl in order enable you to come to a correct decision upon this important subject.

I am, &c.,
JOHN RENNIE.

Sir C. Sharp, Chairman of the Commissioners.

No. 301.
G. Rennie, on the formation of Wet Docks.

No. 301.

Report by GEORGE RENNIE, Esq., C.E., *on the formation of Wet Docks at Sunderland.*

GENTLEMEN,

London, 24th November, 1832.

Agreeably to your directions, I reached Sunderland on the 14th ultimo, and on the 15th following, after receiving instructions from the Commissioners, proceeded in conjunction with Mr. Walker to survey the harbour of Sunderland.

In this survey we were very materially assisted by several of your Commissioners, by Mr. Murray, your superintendent engineer, and by others well acquanted with the port, and having satisfied ourselves by personal observation of the truth of many of the statements communicated to us, beg to report as follows:—

The inconveniences of the harbour of Sunderland, its limited capacity, and the consequent impossibility of accommodating the whole of its increased trade, have been so often discussed and commented upon in the Reports of different engineers, from the first Report of Mr. Labelye in the year 1748 down to the Parliamentary investigation of last spring, that it would be almost impossible to suggest anything new upon the subject.

The excellent surveys made by Mr. Giles, under the inspection of the late Mr. Rennie, between the

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years 1819 and 1820, leave nothing to be desired on the point of locality; nevertheless, as in order to come to a right understanding of the question it is necessary to enter into a few details, it is trusted that it will not be considered as trespassing too much on your patience by endeavouring to describe the locality as briefly as possible.

By inspecting the plan of these surveys it will be seen that the harbour of Sunderland is comprised by that part of the River Wear which is bounded on its north and south sides by high banks on which the towns of Monk Wearmouth and Sunderland are situated. The length of this part of the river, reckoning from its natural mouth near the Potato Garth upwards to the Lambton and Hetton Staiths, may be better than one mile.

Its breadth, exclusive of the Potato Garth, is very irregular, being as much as 600 feet opposite the North Sand, and only 240 feet under the bridge. But its average breadth may be about 350 feet, its capacity therefore may be about 40 acres.

The depths at high water of ordinary spring-tides vary considerably, being as much as 24 feet opposite to the Old Quay, and about 15 feet on the Shoals. But its average depth at high water may be about 16 feet.

The depths at low water vary in the same proportion, namely, from one foot on the Shoals to 11 feet opposite the Old Quay; but the average depth may be about 3 feet.

These depths, except where the bottom is of rock, are of course liable to be affected by freshes and other local circumstances.

Next, with regard to the tides, it is well known that the main set of the flood tide in the offing is from north to south, and the reverse upon the ebb; that there is also a counter current along the sea-shore, which makes the first flood about an hour earlier than in the offing, and which gliding along the shore from the north, is caught by the pier-heads and indraught of the harbour; it then approaches and runs parallel to the north pier until opposite the north pier jetty, from which it runs over the tail of the Potato Garth, and thence in a channel midway between both banks of the river.

The observations made recently under our direction correspond nearly with those of Mr. Giles, On the 9th of November last, two hours and a half before high water and one day after full moon, the set of flood-tide was found to enter the harbour nearly midway between the two pier heads, taking a direction towards the north-west along the interior side of the north pier until opposite the north pier jetty, when it held its course at the rate of two miles per hour midway between both banks of the river.

By an experiment made on the 13th following (five days after the full moon, and two hours after high water, with a light wind blowing from the north-west), the main current of ebb-tide was found to run parallel, or nearly so, to the current of flood-tide, *hugging* the low-water shore of the Potato Garth, and the north pier down to the sea, at a velocity of one mile and three furlongs per hour.

At three hours after high-water the line of main currents of the tide was nearly the same, with the exception of a slight divergence near the north pier jetty, the velocity was then one and a half mile per hour.

Again, from an experiment made recently on an index attached to the north pier, one day before full moon, on the periodical rises and falls of the tide—the duration of flood and ebb-tide was three hours each tide—the duration of slack water was about twenty minutes, and the periodical rises and falls of the tide for each quarter of an hour were nearly alike.

The banks of the river for several miles upwards are of great elevation, and consist principally of limestone-rock. They are also covered with such valuable property as to render it next to impossible to construct a dock in any other position than the Rector's Gill and the low ground opposite Southwick Reach.

Below the Ham Sand Point the river suddenly expands on to the Potato Garth, by which its velocity and depth are considerably diminished, and the width of its low-water channel contracted to one-half of the low-water channel above, the width at this place being only 130 feet.

The remarkable formation of the Potato Garth (which might anciently have been the mouth of the river) approaches, when dry at low water, in form to a semicircle whose diameter may be about 1600 feet, and radius 800 feet, thus presenting an area of 20 acres at low water. It has always been considered of great importance to the harbour as a receptacle for tide-water for scouring the bar, and for tranquillizing the swell of the sea in the storms from the eastward. Notwithstanding which several propositions have been made for converting it into a dock; one by Mr. Dodd in the year 1794, and the other by Mr. Jessop in the year 1807. There are, however, many difficulties attending it which cannot be discussed at present.

On the north of the Potato Garth lies a low triangular piece of sandy ground or bent grass, of about 23 acres in area; the height of its service is very irregular, but its average height may be about six feet above ordinary spring-tides.

It is bounded on the north-west by a cliff of limestone-rock, on the east by the sand-hills of the sea-shore, and on the south by the Potato Garth and part of the north pier.

The soil consists of fine sea sand resting on a bed of clay or marle, which latter rests upon the limestone-rock at various depths (according to the borings) of from 20 to 27 feet, and towards the south-western angle the depth from the surface of the ground to the rock is as much as 57 feet. On this spot it is proposed to place the north dock.

The sea-shore opposite is principally of sand, and is bare at low water as far as at the north pier head.

Again, the south bank, from the Coble Landing near Thornhill's Quay down to the lower Coble Landing at the commencement of the south pier and continued southward towards the cliff of the Town Moor, consists of an irregular mass of sand, gravels, and boulders about 10 feet deep from the surface of the Moor and resting on a bed of stiff clay or marle interspersed with boulders and fragments, the whole resting upon a soft and porous limestone-rock whose surface may be about 14 feet above low-water mark. The surface of the Moor is elevated on an average about 35 feet above high-water mark, but in consequence of the inroads of the sea, this part of the coast is fast wearing away; since 1819 the sea has advanced on the land at least 100 feet, or at the rate of from 8 feet to 9 feet per annum.

From the cliff next the south pier to the low-water mark, the sea-shore consists of a narrow strip of sandy beach, usually termed Sandy Bay. Its breadth may be about 600 feet, and its slope varies from 8 degrees to 10 degrees. Farther to the westward beyond Fort Point, the sea-shore consists of limestone-rocks which crop out to the height of 4 or 5 feet above the level of the sand. It is proposed to place the south dock opposite this shore.

A plan has been exhibited to us, which, in justice to your resident engineer, it is proper to notice.

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Mr. Murray's plan is to convert part of the existing river, amounting to upwards of 24 acres, into a wet dock with suitable basins. The advantages he proposes are deserving of attention; but although we willingly bear him out in several of his positions, there appear to be practical difficulties attendant upon it which can hardly compensate for the expense of carrying it into execution. Confining our attention, therefore, to the sites pointed out to us for docks, the subject has been considered with much attention, not only with reference to the localities which under all circumstances are the best that could be selected, but to the mode of rendering them practically useful when completed.

The subject is difficult in many points of view on account of the obstacles presented by the natural and artificial state of things, which may be classed under the following heads:—

Natural Obstacles.

1st. The irregular and confined shape of the sand on both sites.
2nd. The moderate depth of the river.
3rd. The narrow width of its navigable channels.
4th. The exposed state of the harbour in storms from the eastward.
5th. The slow velocity of the current.
6th. The short duration of the tides.

Artificial Obstacles.

1st. The number, size, and great draught of water of the vessels.
2nd. The expedition and cheapness with which the trade must be carried on.

To overcome the whole of these objections is perhaps impossible; all we can do is to modify them.

The principles, therefore, on which the docks are laid down are—

To incroach as little upon the quay lines as possible.

To accommodate the shape of them to the shape of the ground.

To obtain as much water and quay room as possible.

To have asylum harbours out of the tideway into which ships can run when there is sufficient water. These harbours to be furnished with wide entrances and gates for each, to be used when found expedient.

To have locks to lock ships from the tide basins into the wet dock.

To preserve the surface water in the wet dock always or nearly to the same level.

To have conveniences for loading and shooting coals into the vessels, with capsterns, cranes, and other appurtenances of a dock.

To place the entrances in the best position possible for the ingress and egress of ships, so that the entrances of both docks may not interfere with each other.

Plans, estimates, and a general description of docks, according to the foregoing principles, were also prepared as an Appendix to this Report, but as they differed in some respects from those of Mr. Walker, it was deemed proper to withhold them to prevent embarrassment.

I have, &c.,
GEORGE RENNIE.

To the Chairman and Commissioners of the
Harbour of Sunderland, &c., &c., &c.

No. 302.
Walker, on the formation of Wet Docks.

No. 302.

Report by JAMES WALKER, Esq., C.E., *on the Formation of Wet Docks at Sunderland.*

GENTLEMEN,

London, 24th November, 1832.

In consequence of your having appointed me to meet Mr. Rennie and consult with him on the proper site for the formation of wet docks at Sunderland, we proceeded together to that place and surveyed the different sites on which docks had been proposed, or which seemed suited for the purpose. We also examined the various plans that had been formed by Messrs. Stavenson, Giles, Brunel, and Murray. The principal of the situations were the Salt Grass, the Rector's Gill, the low ground between Monk Wesrmouth and the sea on the north side of the harbour, the space between the town of Sunderland and the sea on the south side, and lastly the present course of the River Wear proposed to be converted into a wet dock according to the design of your resident engineer, Mr. Murray. We took into consideration also the relative facilities of communicating between the docks and the coal districts, and having attended a committee of your body we severally reported our judgment so far as the view we had taken enabled us, but reserved giving any particular or decisive opinion until we should know the result of the measurements, levels, and borings we had ordered to be taken by Mr. Comrie, our surveyor.

Having since received much of the information referred to, I have, with the co-operation of my partner, Mr. Burgess, formed designs* and estimates, and am confirmed in the opinion that the two best sites for docks are on the north and south sides near the mouth of the river; that on the north side being on the low ground lying between the sea and the cliff, and belonging to Sir Hedworth Williamson; that on the south side being principally the Fort, part of the Town Moor, part of your own ground, and extending on the shore of the sea.

The disadvantages of other plans arising either from their distance from the harbour-mouth, their limited extent, or the very expensive interference with buildings and other private property, have been so much discussed and are so well known to you that I think it unnecesary to lengthen this report by going into any detail respecting them. The advantage of the south side as the situation for a dock for loading cargoes consists in the nature and extent of the ground, the valuable part of which is already your property, the proximity to the entrance of the port, the nearness to Sunderland, which is perhaps equally important for the convenience of shipping as for the trade of the town, and the facility of communicating with the dock from the present working coal districts by railways. The very high level of the Town Moor is unfavourable; but this point and the question respecting the shore in front of the Moor will be more particularly considered afterwards.

The favourable level of the ground on the north side, its extent being considerable, its position near the entrance, its being all the property of one gentleman who is deeply interested in the prosperity of the port, and particularly in the improvements on the Monk Wearmouth side, and being with little exception either unlet or let to yearly tenants, make the north side eligible for a dock to receive loaded vessels, as well as for loading coal from the districts north of the Wear should this be required.

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* Since the designs were completed they have been agreed to and signed by Mr. Rennie, with the exception of the tide-basins and groynes, which he left to be discussed by the Commissioners.

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As your Committee expressed a desire to commence with works of limited dimensions, I have considered how a dock on the south side of about eight acres with an entrance-basin, and one of about six acres on the north side, can be most easily and economically formed, and the plan marked A is what I beg to propose for this. But in every case I am acquainted with the formation of one dock and the advantages derived from it have led to an increase of trade and to the necessity for further dock room, and for this reason I always consider it important so to make the first or smaller plan as to have reference to future extension, that while complete in itself it may also properly form part of a larger design when an increase of dock room is thought desirable. The plan marked B is therefore drawn to show what the ground is easily capable of, and how it should be applied, either at present or at some subsequent time. There can, however, I think, be no doubt of the propriety of applying for power now to purchase the premises necessary for the larger design.

The plans show the position of the proposed works in relation to the sands and rocks and to the town; and here the question of building within the line of high water on the south side naturally presents itself. At present vessels that are forced on shore by accident or stress of weather are driven on the sand immediately behind the pier, or lifted by the waves over the rough rocks beyond the sand until they reach the high-water level and the sloping sand at the foot of the cliffs, where if strong they are sometimes saved, and but few if any lives are said to have been lost. Although there have been no cases of the kind since 1829, and though the introduction of steam tug-vessels tends much to decrease the probability of their occurring in future, yet if the consequence of forming an erection within high-water mark for the purpose of making docks were materially to diminish the protection, it might be difficult to justify doing so; but I think that a little consideration of the circumstances will show that any apprehension of the kind is groundless.

It is notorious that the sea has for a series of years been carrying away the clay cliffs on the east coast of England in almost every place, and in many places much more than at Sunderland. It is stated that thirty years ago the cliffs here were generally fifty yards nearer the sea than they are now; measurements* on which I can rely prove that in 1819 they projected in some places twenty yards and in others not less than forty yards more than at present, but at all those times the sand-bank in front of the cliff existed to the same average level as it does now, and formed as useful a protection for shipping. The process I conceive to be that the cliff checks the velocity of the wave which has brought up the sand with it, and that the returning or back wave is slow at the commencement of its motion, which causes the sand to be deposited at the foot of the cliff: therefore along the bottom of all the clay cliffs on this coast and on the shore generally we find a bank of sand, somewhat lower after a continuance of easterly and higher after westerly winds, but generally about the level of high water of high tides. If then it were possible to advance the natural cliff to what it was half a century ago, we should undoubtedly soon find the sand-bank in front of it again, and the same effect would result from carrying a properly formed sea embankment to the same extent, with this difference, that vessels would not have to be lifted over so great a length of rough flat rocks to reach the sand as at present.

In the plan now before you I propose also to increase the safety of this place by carrying out groynes or jetties from the new works towards the sea. The operation of these will be to stop the sand on its passage from north to south, which is its natural direction, and to fill the spaces on the north side of them. The groynes will in fact form as respects the sand other north piers, and their effects though not equal in extent will be similar. If it were necessary to give other examples, I might refer to the small wooden groynes carried out in many places on the coast for stopping the sand and defending the lands behind the cliffs, or to Yarmouth Pier, which is another instance on a large scale, and where exactly the same process has taken place. I have calculated on the groynes being each about 100 yards long, which will be sufficient at first; but their expense is not great: they may be carried out farther, as found expedient, or raised, but not higher than the sand rises in front of them, so as to prevent fear of danger from their projecting above the average surface. Independently of the dock question, I cannot but consider the effect of these groynes as a positive improvement in the case of vessels being driven behind the south pier, just as being driven to the north of the piers is less dangerous than to the south, from the former being a sloping sand and the latter with little exception a surface of rough rocks; and even should no docks be formed, such groynes would be the cheapest and best means of preventing the continued encroachment of the sea on the Town Moor.

I have given much consideration to this very important question and have endeavoured, to view it without prejudice, and my opinion is that the safety of vessels will not be prejudiced by the works I have proposed next the sea. If I am in error, if it can be shown that the works would create danger to shipping and lives, it is evident that no change in the line of sea-wall, nor even excavating the dock entirely out of the Town Moor, would mend matters, while the addition to the expense would be about 10,000*l.* an acre, exclusive of the value of the ground. The sea would still reach the wall, and vessels would be driven against it with nearly the same violence, but with increasing risk from having to be beaten over a greater extent of rock before they reach it. Even if the whole of the works were constructed inland so as to leave the cliff between them and the sea, which would still more increase the expense and inconvenience, it is evident that at the rate the sea is encroaching it would soon reach the works and render a sea-wall necessary; so that either I am right in the general principle I have laid down, or the correction of my error would be an argument against docks on the south side at all, and not only against them, but against every measure that might be taken, including the one I have suggested, for preventing the inroad of the sea and preserving the Town Moor or the buildings behind it.

The accommodation given by the plan A consists of a dock of 8 acres on the south side, with a half-tide or inner basin of 3½ acres and a tide-basin of 2 acres, and on the north side a dock of 6 acres, with a tide-basin of about an acre; making on the two sides a surface of 17½ acres within gates, or dock room for 175 sail at ten ships an acre, besides 3 acres of tide-basins.

By the plan B the dock on the south side is increased from 8 to 20 acres, by extending its length without any addition to the entrances, while on the north side an increase of 7 acres of dock is obtained with a half-tide basin of 3 acres, an additional communication with the river and a small tide basin. In this design the docks alone are capable of accommodating 330 ships, exclusive of the inner basin, which will receive 65 more.

The difference therefore between the two plans affects only the question of dock room on the south side, but on the north the convenience of the whole is much improved by the additional entrance at the

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* Made by Mr. Giles in 1819 and by Mr. Comrie now.

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west end, which is well situated for the admission of vessels in point of distance from the harbour-mouth and consequent freedom from sea.

The amount of the estimate of the works on the south side, according to the smaller plan A, is	£128,070
And of those on the north side	56,740
Making together	£184,810
By the plan B the works on the south side amount to	£177,050
And on the north side to	154,620
Giving a total of	£331,670

But these latter sums are on the supposition the extended plan is carried into effect at once. If the works forming the difference between it and the plan A be not executed till some subsequent period, there will be an increase of expense arising chiefly from the division walls and quays shown by dotted lines on sheet B and marked *a*, *a*, which will then be required, while at the same time about three-quarters of an acre will be taken from the area of the north dock. In this case the estimates will stand thus:—

For the works on the south side	£185,030
For those on the north side	163,800
Together	£348,830

The above estimates are the results of very detailed calculations from the surveys and trials of the strata so far as they have been taken. All the works shown on the plans are comprehended; also the deepening of the flat in the river near the proposed upper entrance of the north dock, the deepening of the approaches to all the entrances, moorings in the docks and on the quays, capsterns at the several communications, booms across the outlets, and dolphins in the river, with an allowance of 10 per cent. for contingencies in all cases. The estimates are exclusive of railroads, sheds, and the purchase of or compensation for property.

It will be observed that the increase of expense of the south side by the enlarged design is by no means in proportion to the increase of dock room for the reason already stated, that the basins and entrances are the same on both plans. And you will also remark that in proportion to the area the south side is one-seventh more expensive than the north if the small plan A be taken, but that in the plan B the south is less expensive than the north in the ratio of about seven to nine. All this is easily accounted for by the shore on the south side being lower than the ground on the north, and also from the strata there being favourable for building purposes: indeed, the estimates of the works on the north side would have been higher than they are if I had not calculated on backing the walls with limestone to be excavated from the south dock. Another cause of the increase of amount by the extended plan on the north side is the great length of quay walls in proportion to the area that is necessary to accommodate the shape of the Potato Garth, as I am aware with what jealousy any encroachment would justly be viewed.

I beg to refer you to the drawings for the particular arrangement of the works and the modes of communication, and to the abstract annexed to this report for a comparative statement of the accommodation afforded and the amounts of estimates according to the respective plans. The depth of the docks on both sides is 16 feet 6 inches at ordinary spring-tides; that of the basins, locks, &c., 17 feet 7 inches. The locks are drawn 130 feet long and 32 feet wide: iron carriage-bridges are placed over them and over the other interior communications, and the river entrances are crossed by foot-bridges. The widths of the several quays are shown on the plans.

The south dock, you will observe, communicates by a lock with the inner basin, which again has two communications with the tide basin; one by a lock of the dimensions stated above, the other by a single pair of gates 50 feet wide to admit large steam-boats as well as steam-tugs. If steam-vessels for light goods and passengers should ply from Sunderland the west side of the basins would form berths very convenient for communication with the town. As the wide gates are supposed to be shut soon after high water one pair is considered sufficient, and the locking at other times will be through the smaller opening. The communication between the inner basin on the north side by plan B and the river is also by gates of the larger size for the same reason.

I have placed tide-basins at all the outlets. The object of these is to afford a free communication between the river and the basin without waiting for the opening of gates, and to throw the lock and gate work into comparatively still water, where it will also be free from the risk of damage by any sand or shingle that may be washed into the entrance. There are two openings between the tide-basin on the south side and the river; one 35 feet wide, the other 50, feet for the security of vessels entering during heavy winds, and for the admission of steam-boats. The outlets on the north side are both 50 feet wide. The experience of Liverpool and Hull has proved the great utility of uninterrupted tide-basins, and the disadvantage of lowering the water in the docks or of waiting till near the time of high water before vessels can enter or leave the tide-basins renders I think the use of half-tide basins equally important.

When the communication of a lock with a river is in still water the direction of the entrance or outlet in reference to the course of the stream is not of so much consequence; but in situations where the communications are at all in the tideway and exposed to the waves, the point becomes important. We have drawn all the communications with the river pointing upwards, because—

First—The passage in and out is almost always during the tide of flood, so that the direction is not opposed to the current.

Second—All the communications may be used for vessels entering as well as leaving the docks. There is no question as to which is the proper direction for entering, and ships going out will swing into the river with less trouble by going with the stream than if obliged to stem the tide, by which they would be forced against the upper pier of the entrance.

Third—Pointing upwards is advantageous for lessening the surge of the sea in the tide-basins and at the gates, and preventing the gravel and sand from being driven in.

As to the relative advantages of the north and south sides for the passage of ships, it may be necessary only to say that the entrances are made wide enough for powerful steam-boats to go through, and for vessels in case of a strong head wind and rough sea, and that the argument against the south side of the wind being unfavourable for ships getting out when it is fair for London may be met by

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the statement that the southerly winds are the most prevalent, and that the use of steam-tugs renders the direction of the wind less important. Both views of the question are so far correct, but as it is impossible to make an entrance on either side that will meet all the objections which may be brought forward, your resolving to form a dock on each side should be a satisfactory answer to all parties, and will save me the trouble of giving any particular opinion on the balance of comparative advantages. If, however, Sunderland allows itself to be divided into parties, and time to be wasted in bickering as to the advantages and disadvantages of the north and south sides and the exact manner in which shipping or property is to be rated, while your enterprising neighbours at Seaham and Hartlepool are in full activity, it requires no power of divination to foresee the consequences. More important interests than even those of Sunderland and Monkwearmouth have been sacrificed in this way. To gentlemen who by daily experience are well acquainted with the difficulties, danger, and damage arising from the very crowded state of the harbour and from ships grounding on the hard rocky bottom, it would appear almost unnecessary to say anything of the advantage that would be derived from convenient docks in which vessels would be always afloat and free from the evils of flood and ice, and yet it is perhaps only by those accustomed to such a scene that the confusion and crashing to be occasionally witnessed in Sunderland could be at all borne. That those evils form a serious drawback on the local advantages of the port in reference to the coal-fields there can be no doubt, yet despite of them Sunderland has become one of the principal sea-ports in the kingdom, because there *was* no port or communication with a port from which the same coal could so conveniently be shipped. *But is this state of things likely to continue if Sunderland be not improved?* Seaham, Hartlepool, the railways to the Tees and those projected to Shields on the one side and to Hartlepool on the other, answer the question; and if the answer does not create a spirit of activity as well as unanimity among those concerned in the trade of the Wear they must view their interest very differently from what I do. Bristol, by depending on its previously growing trade, allowed itself to be anticipated by Liverpool in the formation of docks, and was forced to follow the example when Liverpool had, through the improvements themselves, become too powerful and wealthy a rival.

The question of rates for defraying the expense of making the improvements, and whether they should be paid only by vessels using the docks or be borne by the shipping generally, and partly also by the property in and near the towns, is not my province. I would only observe that by relieving the river of the excess of vessels beyond what it can fairly accommodate, those continuing to use it would derive considerable advantage, though not equal in degree to ships entering the docks; and that as the value of the buildings and ground depends almost entirely on the shipping frequenting the port, every owner of property must have an interest in the accommodation being good and the rates on vessels at the same time moderate, a direct heavy tax on them being indirectly a drawback on the value of all houses and lands on and near the Wear.

I am, &c.,
JAMES WALKER.

To the Commissioners of the River Wear.

ABSTRACT OF ESTIMATES.

	Acres.	Acres.	Amount.	Cost per Acre.	No. of Vessels.
Plan A.					
South side.					
Tide basin	2				
Half-tide basin	3½				
Dock	8				
		13½	£128,070	£9,490	135
North side.					
Tide basin	1				
Dock	6				
		7	56,740	£8,110	70
		20½	£184,810	£9,010	205
Plan B, if executed at once.					
South side.					
Basins as above	5½				
Dock	20				
		25½	£177,050	£6,940	255
North side.					
Lower tide basin.	1				
Upper tide basin.	¾				
Half-tide basin	3				
Dock	13				
		17¾	154,620	£8,710	177
		43¼	£331,670	£7,670	432
Plan B, if prospective.					
South side.		25½	£185,030	£7,260	255
North side.		17	163,800	£9,530	170
		42½	£348,830	£8,210	425

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No. 303.

Murray, on forming a Floating Harbour of the River.

No. 303.

Report of John Murray, Esq., C.E., *proposing to convert the River Wear into a Floating Harbour.*

London, *9th January*, 1843.

Coal is the staple commodity of the port of Sunderland, and its export amounts annually to 1,300,000 tons, which is gradually on the increase. Its foreign trade is also extensive, and great quantities of timber are imported for ship-building, colliery, and other purposes. More ships are annually constructed there than in any other English port. It has rapidly advanced from a mere fishing village, to be the fourth harbour in the kingdom, as respects the aggregate amount of its tonnage; and from the building of slow sailing colliers, to that of mercantile ships of the largest class. Manufactures have also sprung up to an almost incredible rate in the locality, and have flourished with all the other branches of the commerce of the port. The united towns of Bishopwearmouth, Sunderland, and Monkwearmouth contained, at the last census, nearly 60,000 inhabitants.

The Conservators of the River Wear and port of Sunderland are a numerous body of the most influential landed proprietors, coalowners, shipowners, and merchants in the neighbourhood; and have been intrusted with their important charge by several Acts of Parliament. Since the time of George I. certain dues have been collected by them on the shipping frequenting the port, and on the coals exported from it. These funds have been appropriated in carrying into effect extensive works for the improvement of the River Wear and the harbour of Sunderland; and which consisted chiefly in deepening the shoals, the removal of rocks and other obstructions, and the building of piers at the mouth of the river.

In the year 1809, the average burthen of vessels belonging to the port was about 150 tons; a large ship being then reckoned 250 tons burthen, and which, after taking in two-thirds of her cargo in the harbour, had to cross the bar, on account of the deficiency of water, and take in the remainder, while lying at anchor in the roads, from flat bottomed keels.

Even a few years ago, it was only at the top of the spring-tides when there was sufficient water in the channel and on the bar to allow vessels of the ordinary size to leave the harbour; and if the weather happened at that time to be boisterous, in consequence of easterly gales, the spring-tides passed over, and the vessels had to wait till the next. Numerous ships have been thus detained, and the harbour has been crowded to a very great extent, causing many of them to take the ground in their loaded state, in very awkward positions, and some of which have in consequence received considerable injury. It has been calculated by one of the largest shipowners of the port, that from the above cause, the average loss could not be less than from one to two per cent. on the capital invested. The actual amount of damage sustained by the shipping cannot, however, be ascertained, as some of the damaged vessels were not insured in the harbour, and no account is therefore kept of them; but the agents of the various shipping policies of the ports state that 8,000*l.* per annum have been paid for such repairs.

The Commissioners of the River Wear have for many years paid particular attention to improving the channel and deepening the bar. They consulted that eminent engineer, the late Mr. Rennie, and his plans were to prolong the piers with solid masonry into deeper water. The north pier is now completed to the full extent, and the south pier has been also lengthened, but it is considered advisable to let it remain as it now is, to see the result, from altering the other pier. The most beneficial effects have been produced by the adoption of these plans: the channel has been straightened and deepened by dredging, and the bar has been lowered and kept in a stationary position by the judicious direction of the piers. There is now about four feet of water upon it in the fair way at low water of spring tides, or 18½ feet at high water of ordinary spring tides, and about 22 feet during equinoctial spring tides. Great facility is consequently afforded to vessels entering and departing from the harbour, and ships drawing from 15 to 18 feet now cross the bar with greater safety than vessels of half that draught of water could do previously to such works being executed; indeed, ships of 350 tons burthen are now in the habit of going to sea, drawing 14 feet of water at dead neap-tides.

It is only within the last thirty years that railways have been brought into general use for the transport of coals from the mines to the sea-borne shipping. Formerly the whole of the coals were taken from the mines to the most contiguous stations on the banks of the river, where they were transferred from the waggons into flat-bottomed keels. These navigated the river in great numbers, and conveyed the coals to the harbour, where they were cast by manual labour on shipboard. The frequent turning of the coals caused much breakage, and depreciation in their value, and the proprietors were thus induced to abandon the transfer of the coals into keels, and to bring the waggons directly to the harbour by longer railways, from whence they were discharged at once into the hold of the vessels. The keels have therefore gone greatly out of use, and are only continued by a few of the collieries in the upper part of the river, where difficulties exist in bringing the railways directly to the harbour. Large sums have consequently been expended by the coal proprietors in the formation of railways, and procuring stations with valuable machinery for their shipping staiths on the banks of the river, in and adjoining to the towns of Bishopwearmouth, Sunderland, and Monkwearmouth. In conjunction with the Commissioners of the river, the late Earl of Durham and the Hetton Coal Company, within the last six years, have expended 13,242*l.* in widening a very contracted part of the river above the Rector's Gill, and excavating the rock from the bed of the river by means of coffer-dams to a depth of from 10 to 12 feet at low water, to give increased facility to the shipment of coals. A considerable sum of money has also been expended by the Durham and Sunderland Railway Company in deepening their shipping berths.

The shipping of the port may be said to be confined to the channel of the river from near its mouth for a distance of two miles upward. At the beginning of the present century, its shipping was of an inferior class and small tonnage. The vessels were strongly built, and so constructed as to take little damage when lying a-ground; but the rapid increase of trade and the improvement of the port have caused numerous ships to frequent it, ill adapted to withstand the strains to which they are necessarily subjected. The vessels now belonging to the port are chiefly of a large class, and of such a description as to make it extremely probable, without further improvement, that they will sustain great damage by straining and lying badly when a-ground.

Various plans for the formation of wet docks have been brought forward at different times by engineers of professional eminence. A residence of upwards of ten years at Sunderland has afforded me the means of judging what are the exigencies and requirements of the port, especially as my professional avocations have engaged me in taking that charge over the river, the duties of which in other

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ports devolve upon a principal harbour-master and surveyor. The subject of Docks has been frequently brought under my notice, and the following are my opinions thereon :—

The late Mr. Jessop suggested the idea of excavating the shallow ground, called the Potato Garth, near the mouth of the harbour, and enclosing it from the river by means of a wall parallel to the south pier. It is evident that a large space might there be obtained for wet docks. But the disadvantage attending its conversion into this useful purpose was very great; as this receptacle has been conceived to be of essential use in allowing the waves during stormy weather to expand and break themselves upon it. If enclosed, the range of the sea would naturally run up the confined channel of the river, and prevent vessels from making use of the lower part of the harbour. The Commissioners have therefore, with the advice of the engineer appointed by the Admiralty, always attempted to prevent the slightest encroachment upon this valuable receiver.

I shall pass over other designs made by various individuals from the time of Mr. Jessop, to those of Mr. Robert Stevenson, of Edinburgh, who in 1829 was specially employed by the Commissioners, to report on the subject.

He projected several works :—

1st. A dock on the north side of the river formed partly upon the Potato Garth, above alluded to, which, though not so objectionable as Mr. Jessop's design, would still have been injurious.

2nd. A dock on the sea-shore, on the south side of the river; the estimate for constructing which, without going into further detail, was much greater than the trade of the port could afford.

3rd. The conversion of the lower part of the navigable channel of the River Wear, from the Old Low Ferry to Southwick, into a floating dock, and forming a tunnel for the passing of the flood and ebb waters through the high ground of Monkwearmouth. The estimated expense of this work amounted to 233,260*l*, the interest upon which would have caused so heavy a tax upon the shipping as to drive it elsewhere.

4th. A smaller portion of the river at Southwick was proposed to be enclosed by dams with locks, and the formation of an open cut from the Patent Ropery to the Hetton Staiths; the estimate for which was 165,622*l*. This projected dock was too far from the town, and on the opposite side of the river to the principal collieries to be of much use, and it was considered that great difficulty would be experienced in getting a sufficient number of vessels to sea in one tide from a dock so distant from the bar.

Mr. Giles, in the year 1831, projected an extensive dock along the sea-shore in front of the Town Moor, with a tidal basin, locks, and other outlets communicating with the River Wear through the yards of the Commissioners. The project was carried into Parliament, and, after a long discussion, was thrown out by a Committee.

Mr. Brunel, at the same time, projected a dock on the low ground, on the north side of the river, northward of the north pier, communicating through it with the river, and by continuing the dock to skirt the high ground and the Potato Garth, he proposed an upper communication with the river at the Ham Sand. This project was also carried into Parliament, and after passing the House of Commons, was rejected by a Committee of the House of Lords.

In the early part of 1832, I laid before the Commissioners a scheme for converting the lower reach of the harbour into a wet dock, with tidal basins attached. Advantage was proposed to be taken of the bend in the river at the ferry-boat landing, and thus obtain an area of about 24 acres. It was proposed to make the navigable channel through the opposite town of Monkwearmouth nearly in a straight direction from the bridge to the mouth of the river, by which the scouring power on the channel and on the bar would have been increased. The estimated expense of carrying this undertaking into execution, including the purchase of property and buildings upon it amounted to 200,000*l*.

The Commissioners in the latter part of 1832 called in Mr. James Walker and Mr. George Rennie to give designs for a small dock on each side of the river capable of extension as the necessities of the port might require.

The sites chosen by these engineers were nearly the same as those previously adopted by Messrs. Giles and Brunel, but the details of the plans were somewhat different. The estimated expense of carrying even the designs for the small docks into execution was 184,810*l*.

The Commissioners deposited these plans in Parliament, but they abandoned the north side dock in consequence of a wish expressed by the original proprietors to carry out the plans themselves under the sanction of a charter, and they were obliged also to abandon the proposed dock on the south side by being served with the notice of an injunction from the Hetton Coal Company and others.

A dock designed by Mr. Brunel of eight acres, with a small tidal basin attached, and communicating with the River Wear near its mouth, has been since carried into execution by a private company on the north side of the river, on the low ground northward of the north pier.

A railway has been also formed to connect it with the Brandling Junction Railway, and by means of it with some collieries on the northern side of the river, which bring their coals to the dock for shipment. It is therefore useful to vessels which enter and take in their cargoes there, and for vessels lying up during the months of winter. Even with the accommodation of this dock many vessels are compelled, however, to be laid up during the winter months in the river out of the fair way, where they are exposed to injury by straining, chafing their bends and quarters, with other wear and tear. At the breaking up of winter they are, of course, necessarily exposed to the action of the floods and ice. In the month of January, 1841, the ice broke up suddenly and came down the river with great impetuosity, tearing away the moorings and setting the ships adrift upon other vessels, which in their turn were swept away, whereby dreadful destruction of property ensued in one night.

To meet the requirements of the port a dock, to be generally useful, must, be connected with the southern side of the river, which is the chief seat of trade, and where the principal railways are in connection with the adjoining coal-mines.

Various objections may be urged against a dock on the sea-shore on the south side of the river, nor would an excavation from the contiguous Town Moor make it any better.

1st. The expense of constructing a dock there of any extent to be practically useful, would require the shipping to be taxed with dues far exceeding what they now pay in the neighbouring ports for the accommodation of lying afloat.

2nd. If made, a large additional sum of money would necessarily have to be expended in bringing the railways to the dock. The staiths and machinery now in use would also have to be abandoned, which would sacrifice much valuable property, and the alteration of the seat of trade from one place to another would injure in a very great degree the long-enjoyed privileges and property of the merchants contiguous to the shores of the river and present harbour.

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3rd. The position of the dock along the sea-shore would expose the shipping in it during a dense fog in case of war to the attack of the enemy's rockets and shells, which, if thrown into a dock so situated, filled with shipping during the period of low water, would undoubtedly do incalculable damage.

The three contiguous towns of Bishopwearmouth, Sunderland, and Monkwearmouth, are built on both banks of the river, which are either naturally steep, and in some places precipitous, or made so by the deposit of ballast from the shipping; consequently it would be very expensive to make any cut for the passage of the waters of the river, in the event of converting the present channel into a dock, either according to the plan of Mr. Stevenson, of Edinburgh, or that of my own in 1832, where the cut proposed by me, though much shorter than the other, and not through such high ground, is yet covered with streets and buildings. A better acquaintance with the locality than I had in 1832, causes me to form an opinion that some other plan must be adopted than the formation of any cut through the town of Monkwearmouth. The foregoing are the sites which have hitherto been pointed out for wet docks, and the difficulties attendant on carrying out the designs have been chiefly the cause of their non-adoption.

It may be proposed that the River Wear may be deepened in a similar way to the Clyde at Glasgow, and thus afford additional berthage to laden vessels, and keep them afloat, without penning up or impounding the water. But a great part of the bed of the river in the lower part of the harbour is composed of limestone-rock, the removal of which would be a work of time and cost much money. The quays throughout almost their whole extent are also very indifferently built with masonry of an inferior description, and have their foundations at and in many cases above the low-water mark. They were constructed many years ago, when the harbour was nearly dry at low water; and they are in no way adapted for a tidal river so improved as the Wear. If any greater deepening be attempted, the whole line of quays on each bank must be rebuilt (not being worth underpinning), and many of them have warehouses and other buildings resting upon them, so as to increase materially the expense of their renewal. The dredging-machines now in use by the Commissioners for deepening and maintaining the existing state of the harbour, seldom approach nearer than sixty feet to the quays on each side. By working more closely they would be greatly endangered, and in some instances they have actually been brought down; but such work has been done only at the request of the proprietors themselves, who took the risk and responsibility of such a proceeding. Any increased deepening therefore of the harbour would be attended with a greater outlay of capital than the port could afford, and a large expenditure would also have to be incurred annually to maintain it.

The coal-trade of the port of Sunderland is of a peculiar nature, and is carried on in vessels of various tonnage. On account of the uncertainty of the winds, these frequently arrive in large fleets, each vessel requiring the loading of its cargo, and fitting out to sea as speedily as possible for another voyage. A stranger would be surprised at the stream of ships tugged by steam-boats passing out of harbour, about the time of high water, if the wind be favourable for a London voyage, or if easterly winds prevail for a few days. It is very doubtful, therefore, whether any increased accommodation would be given to the trade by wet docks, in consequence of the delay and detention of passing so many vessels in one tide, throughout locks either directly from the river, or from a tidal basin. To obviate this difficulty as much as possible, the vessel should be allowed to pass at once from the river into the wet dock through openings, the gates of which should not be closed till some time elapse after high water, and they should likewise be opened again some time before high water, for their egression. Locks which are so useful generally, are here inapplicable except for the admission of light vessels, when the other gates are closed; for the laden vessels would always leave the dock at the time of high water, in order to cross the bar with the greatest depth of water upon it.

From what has been stated above, it will appear that there is nothing new in the design of converting the lower part of the River Wear into a floating dock; but the idea of admitting the flood-tide through the navigable gates, and allowing the ebb to run through them also for three hours after high water, retaining the latter part of the ebb for the purposes of scouring the channel to sea and the bar, has never yet in this country been carried into execution. This project is now brought forward by the Commissioners under my advice. They have made the necessary arrangements for applying to Parliament during this session for an act to enable them to carry the same into effect.

The following are the leading features of this projected improvement:—

The lower part of the River Wear, forming the present harbour of Sunderland, is proposed to be converted into a floating dock, by placing a wall of masonry, with a waste weir and flood or sluicing gates, together with piers, and navigable gates between them, running diagonally upwards and across the river, from the high Coble Slip to the Folly End, and from that downwards to the sand point called the Ham Sand, enclosing a tidal basin on the northern side of the river, as is shown more particularly in the accompanying plans. These works are intended to pen up or impound at least seven feet of water above the present low-water mark of spring-tides at the Folly Point. One hundred acres of water will thus be rendered available to shipping, producing at Pallion a depth of five feet in the channel there, and in the vicinity of the gates an average depth of twelve feet, which is considered, sufficient to afford every facility for moving ships in and out of the berths at the different coal staiths and to keep the laden vessels afloat, thus saving the great damage above noticed.

Two openings are proposed to be formed for navigable purposes, each to be eighty feet in width, with skeleton gates placed in them, containing sluices or slackers for more easily shotting them, or letting off the water when required. These gates are proposed to be left open till three hours after high water, or when the water has half ebbed, there being then at spring-tides seven feet above the present low-water mark. Ample time before closing the gates will, therefore, be given for ships passing outwards. The gates, it is intended, shall remain closed till the tide flow again to the level of the impounded water of three hours' flood, when the tidal water will force them open, and the navigation of the river will proceed as at present.

It is also proposed to construct a tidal basin for the accommodation of steam-tugs and other vessels, which may enter the harbour even at low water, if there be a sufficient depth on the bar. By this arrangement it is evident that, although the large gates would be closed for six hours, yet the navigation of the river, in reality, could not be considered to be interrupted; for only very small vessels, and that but seldom, would enter or depart from the harbour after the large gates were closed, and these would only have to encounter a detention of, say from ten to fifteen minutes, to fill the tidal basin with water, and make it act like a large lock. From that basin, vessels, and even boats, could pass either singly, or when ten or more sail have collected together, through an opening at the Folly End into the floating harbour. No difficulty would be experienced about the supply of water to fill the basin at all times, and as there would always be lock-keepers on the spot, the only alteration from

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the present state of things would be, as above stated, a slight detention, in point of time, to the small craft.

The tidal basin may also be rendered available (by placing a pair of gates to point inwards at the Folly Point) for the reception and security of fine-bottomed vessels, in case it should be necessary, from any accident to the large gates, from extraordinary freshes, or other unforeseen causes, to keep them open during the whole of the ebb-tide.

On the closing of the large navigable gates at half-tide, the water on the outer side would continue to ebb away, while it would be rising on the upper side of them. As soon as the penned up water would rise to the top of the gates, or the level of high-water mark of ordinary spring-tides, say an hour or an hour and a half before low water, the sluices would be opened, and an immense scouring-power would thus be obtained, which would deepen the channel outwards, and lower the bar at the mouth of the harbour. Some may be of opinion that scouring a channel by means of sluices only creates irregularity in its bottom, tearing up all before it immediately below the sluices, and depositing the sand and other matter wherever the current loses its velocity. This might be the case in a sinuous stream, but the proposed scouring-power at Sunderland would act upon a stream diverging but slightly from a straight line, and a very limited distance from the bar. A large volume of water would be passed down the channel with great velocity, and the matter thus raised by the increased force would be held in suspension until the agitation of the stream would be lost, far beyond the bar, in the tide passing along the coast.

It is proposed likewise, previously to the opening and working of the sluices, to dredge away a large portion of the shallow ground called the Potato Garth, and to excavate the present low water channel in the vicinity of the sluices to a considerable depth, whereby all the sand and gravel would be removed. The space so excavated is proposed to be filled up for a few feet in depth by a covering of large stones thrown in promiscuously, and roughly packed if thought necessary, by means of the diving-bell, and which from their gravity would not be acted on by the water from the sluices. A permanent and regular depth would thus be maintained, doing away with all fear of sand-banks near the harbour's mouth.

Objections have been made to the proposed scheme on account of the sediment which comes down the river, and which might ultimately silt up the harbour. In answer to this the River Wear may be called the drain of no very extensive tract of country, in a high state of cultivation; much of the interior is in pasture, and consequently the river, although frequently swollen by heavy rains, yet brings with it very little alluvion in comparison with the Humber, the Avon, and other rivers. The deposits, therefore, are very trifling. In corroboration of this, the excavation made in the year 1839 by Mr. Philip Laing at the Salt Grass at South Southwick, has, notwithstanding its being out of the stream and in still water, only received an accumulation of mud, on an average over its whole extent, of 2½ inches, that is, very nearly an inch in depth per annum.

Again, two of the large floating vessels or docks, used for the reception of ships in undergoing repairs, are moored alongside of the quays, in the middle of the harbour, and these vessels are occasionally removed to get the mud excavated from their berths. The one alongside of the north quay, when last removed, had an accumulation of mud beneath it of about sixteen inches, which had taken place during an interval of two years, the vessel being completely out of the stream, and in a place exceedingly liable to silt up. The deposit underneath the other floating vessel is ascertained to be considerably less, and much of the deposit arises in both cases from the cleansing out of the chips and other rubbish, which, careful as shipbuilders are, necessarily get washed out from the interior of the dock, and find a resting-place beneath the vessel.

A test of the nature of the deposits in the harbour is obtained from the works of the dredging-machines. Sand constitutes the great bulk of what is raised. During freshes, when the water is in a muddy state, much of the suspended matter is brought in again by the flood, the greatest part of which is deposited below Hylton, four and a quarter miles from the bar, and where the flood-current ceases, the rise there being only felt by the swelling of the land and sea water. Sand-banks are, in consequence, formed only below that place, and which are in their turn carried downwards by spring-tides and future freshes, causing the deposits in the lower part of the harbour.

The removal of these sand-banks causes continual work for two dredging-machines, belonging to the Commissioners, and with their powerful assistance the river is maintained in its present state.

It is evident that if sand be brought in by the flood-tide, the navigable gates being proposed to be shut during three hours, will exclude a considerable portion of it, which will, in some degree, compensate for any increased alluvion that might be deposited in the river by land floods. If alluvion be deposited, which is very doubtful, it must first take place at the upper limit of the impounded water, and there form mud banks which, before they could accumulate in extent and height to be washed downwards, could be removed at a little cost by a small dredging-machine.

It may here be remarked that the sills of the gates and sluices are proposed to be laid six feet below the present low-water mark of spring-tides, and which being below the bed of the river would, with the under-current, carry off much of the mud and other matter from the sewerage of the town, the exposure of which at present is so offensive and unhealthy.

Another objection made to the conversion of the river into a floating dock is the jeopardy in which the shipping would be placed by the sudden breakage of the ice after a severe winter. On consideration it surely must be evident that the danger would be materially diminished, if not altogether removed. The great damage which generally occurs in the breaking up of ice is occasioned by the velocity of the stream about two or three hours before low water, and the impetus with which it carries along with it the floating ice, striking the vessels with violence, breaking them adrift and tearing up the moorings. All this would be prevented by the proposed works, for the flood and other gates would give a command over the velocity of the current, which might either be checked or increased at pleasure, and the whole of the floating ice might be brought down smoothly and without injury to the shipping into the impounded water of the harbour, from whence it might be passed to sea through the gates and over the tumbling bay gradually, without the risk of causing damage to the vessels in the harbour.

The width of the several openings of the projected works being equal to the breadth of the river at the Folly Point immediately above, and to the breadth between the piers below, near the harbour's mouth, could create no interruption to the passage of the ebb and flood waters, consequently there could be no dread of flooding the lands and other property above the proposed works.

By the arrangement of opening the navigable gates whenever the flag is hoisted on the pier, indicating the water on the bar at half-flood, ships might pass up the river without interruption, and if they took the harbour sooner they could pass into the tidal basin, and be locked into the floating harbour.

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A fleet of vessels, with an easterly gale of wind, frequently takes the harbour close after each other, and if the leading ships meet with any interruption as the harbour is at present, damage is the immediate result by running into each other, breaking bowsprits, and doing other injury. Under the proposed plan, in similar circumstances, the lateral or flank walls, furnished with bollards or posts, would afford great facility for the immediate dropping up and removal of ships, as there would always be men on the piers at such a time, having a connection with the shore by bridges over the tumbling bay and flood gates on the south side, and by the tidal basin gates to the north. By running a rope away to these posts a ship might be checked gradually, and without risk of damage through the large navigable openings into the harbour. These lateral walls would therefore be found exceedingly useful; making the south wall longer than the other with the intention of founding the sluicing gates on the rock, and thus save the expense of an apron, which is so liable to be undermined. Ships might likewise bring up in an easterly gale of wind, by dropping their anchors all the way, from the present dock-entrance to the proposed works, a distance of 600 yards, and as the channel immediately below them is intended to be deepened and considerably increased in width by excavating a portion of the Potato Garth, additional room would be given to prevent their running foul of each other. Vessels, instead of dropping their anchors, might also, as at present, bring up by beaching on the Sand Point, which it is proposed to maintain.

At night a red light might be exhibited from the eastern extremity of each of the lateral or flank walls, and a bright white light from the centre pier between the navigable gates, so that even in foggy weather it would scarcely be possible to steer a vessel in a wrong course.

The rebuilding of the north pier in a more judicious direction than the old one, as respects the run of the ebb-tide and its effect upon the bar, has allowed the waves, during stormy weather, to have an increased power upon the canch or shoal which has existed for many years between the piers near the harbour's mouth, and this canch is much lowered in height and reduced in width: in consequence the waves in stormy weather do not break upon it so much as they used to do. The channel upwards has also been greatly deepened and straightened, and the interior shoal or canch, extending from the engineer's house upwards in front of Thornhill's wharf, has been excavated by dredging, and made into deep water berths. These works have increased the range of the sea within the harbour, and difficulty is now felt in securing the vessels lying alongside of the quays in the lower reach. Two timber jetties have been lately erected by the Commissioners to break the range of the sea, and with some beneficial effect; but the undulation is not entirely destroyed.

It has been proposed to the Commissioners to make the solid part of the north pier westward of the present dock-entrance, of open timber framing similar to the western portion, with the view of allowing the waves sooner to throw themselves upon the Potato Garth, and by rolling there to be broken before they reach the Sand Point. Again, it has likewise been proposed that, in place of erecting more jetties as breakwaters on the South pier, a certain part of it between the lower Coble slip and the engineer's house be removed, and set back in an angular direction, so as to make the pier form a small triangle, the apex of which would be about 70 yards south from the present line of pier; and to excavate the space between the old and new walls as a receptacle for the waves, which, hugging that pier, would throw themselves upon it and be broken.

The cost of this essential improvement to the port of Sunderland is estimated at 60,000*l.*, and if an Act of Parliament be obtained in this session, the works may be so far executed, *without interrupting the navigation*, as to bring the dock into use by Christmas, 1844.

(Signed.)

JOHN MURRAY,
Engineer to the Commissioners of the River Wear,
Port, and Haven of Sunderland.

To the Commissioners of the River Wear.

Approved and sanctioned by us, the deputation appointed by the said Commissioners to wait on the Right Honourable the Lords Commissioners of the Admiralty,

(Signed.)

JOHN SCOTT, *Chairman.*
C. BRAMWELL.

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No. 304.

Report of J. WALKER, Esq., *on the Sunderland Floating Dock.*

SIR,

Great George Street, Westminster, 27th *April,* 1843.

I had the honour to receive your letter of the 29th March last, in which you inform me, that application had been made to the Lords Commissioners of the Admiralty for their consent to the Bill now in the House of Commons, for enabling the Commissioners of the River Wear to effect certain improvements in the harbour of Sunderland; that a large body of ship-owners and other inhabitants of both sides of the harbour had petitioned their Lordships to withhold their consent on certain grounds connected with the well-being of the port, and that their Lordships having reason to doubt the efficacy of the proposed plan, were desirous that I should proceed to the River Wear at my earliest convenience, to carefully examine into the merits of the proposed plan, and after satisfying myself of every important particular, and hearing all that should be adduced on either side, that I should report my mature opinion for the information of their Lordships, bearing in mind that it is not more their Lordships' duty to protect the water and harbours of the realm than to offer no discouragement to substantial improvements and judicious enterprise.

So soon after receiving the above instruction as I could fix to proceed in the business, I informed Mr. Robinson, the clerk to the Commissioners, of my intended visit, so that on my arrival at Sunderland, on the 10th instant, I found the Commissioners and the opposing parties prepared to meet me, and I proceeded at once in the necessary surveys, and in hearing the statements and witnesses of the promoters and opponents of the projected measure; each party produced engineers, ship-owners, captains of vessels, pilots, and owners of property within the limits of the proposed improvements, whose evidence during five days I was engaged in taking at considerable length, until the agents informed me they had exhausted all they could produce at the place.

I have since my return given my best consideration to the subject and to the evidence, a copy of my notes of which is delivered with this Report.

With the exception of the Monkwearmouth Dock, which is on the north side of the river, and opposite to Sunderland, having an area of about eight acres, the only accommodation for shipping in the port of Sunderland, is the River Wear itself.

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The business part of the port commences about half a mile from the outer end of the piers, and extends for a distance of about a mile up the river, the general width from shore to shore being about one hundred yards. Into this space several hundreds of vessels, principally colliers, are crowded. The depth in the middle of the river varies from 4 to 10 feet at low water of average spring-tides, the "lift" of which is 14 feet 6 inches at the sides or shipping berths; the depth, with few exceptions, is less. The inconvenience attending the want of greater depth at the sides arises from the modern method of shipping coal. In former years the coal was brought down from the pits to the wharfs several miles up the river: a punt or barge, called a "keel," carried the coal in "bulk" from the wharfs to the ships, which then lay in the middle of the stream opposite Sunderland, and the coal was then shovelled from the "keels" on board the ships. The time occupied in the passage down the river, and unloading the cargoes by hand, was found inconsistent with the dispatch which the increase of the trade required. The first improvement was to place the coal in boxes, each holding 53 cwt., "a Newcastle chaldron," and to load the keels with eight of these at the wharfs, whence they were floating down the river as before, and hoisted by machinery from the keels into the vessels, which lay outside the keels, but near the shore. This is still continued to a small extent, but the delay attending the passage of the punts upon the river is in, by far, the greater proportion avoided by the formation of railways from the pits to the stages or "staithes" upon the sides of the river, to which the waggons are brought and emptied by "spouts," or lowered by ingenious machinery, called "drops," directly into the ships. This plan, of course, requires the ships to be brought close to the shore, where there is now at low water a want of sufficient depth. The inconvenience of this is twofold; the owners of ships trading to foreign ports, particularly of heavier burthen and sharp build, complain of their vessels being strained, and avoid this port, preferring the Tyne. Injurious delay also arises from a difficulty of getting loaded vessels which have grounded at low water away from their berths, to allow of light vessels taking their places. The consequent delay is felt, not only in the harbour, but the traffic along the railway; and even the work at the pit's mouth and the local working sympathize with it; the last link in the chain ceasing to move, every dependent link does so. It must be evident, even were this not proved by abundance of evidence, that loss is the effect of such irregularity, which is the great complaint of the port.

The next evil in point of magnitude arises from the land floods, which come down with great force from the hilly country of which the Wear is the drain.

In the harbour, which is near the sea, and of which the width and depth are greater than in the parts above, the velocity is less, unless the ships in the port be numerous; but when this is the case, particularly in the breaking up of a frost, when much ice comes down, the damage and loss are very great. A memorable instance of this occurred in January, 1841, in which the damage done to the shipping by the ice amounted to upwards of 15,000*l*.

A third inconvenience is, want of room; and a fourth, the damage done to ships lying at the lower part of the harbour, by the swell that rolls in during easterly gales, which damage is encreased materially if, on such occasions, a large fleet of light vessels enter, following each other, and injuring those they come in contact with.

In his Report Mr. Murray states, at considerable length, the various projects of docks that have at different times been proposed to remedy the evils I have described, through want of capital, and still more, I believe, through want of unanimity among the local interests, combined, it was stated, with political feelings, none, with the exception of Monkwearmouth Dock, have been executed. Lord Durham and the Hetton Company have improved their shipping places above the bridge at considerable cost, and at those there is sufficient depth at low water close to the wharfs, so that the evil I have described as greatest is got rid of. The principal improvements made by the Commissioners are the gradual deepening of the harbour and its entrance, to the extent of several feet, by dredging. A very large sum has also been expended upon the entrance piers.

Notwithstanding the inconveniences that have been incurred, great increase has taken place in the trade and in the population of Sunderland. The following statement is abstracted from statistical information given in evidence by Sir Cuthbert Sharp, for some years chairman to the Commissioners of the Wear, and now collector of customs for Sunderland.

The tonnage in	1802	74,535	tons.
,, ...	1840	188,769	,,
The population in . .	1802	19,102	souls.
,, ...	1841	56,053	,,
Vend of coals in . .	1801	227,628	chaldrons.
,, . . .	1842	509,049	,,
The customs' receipts in	1820	16,888	pounds sterling.
,, ...	1842	119,960	,,

In 1787 the average tonnage of the vessels frequenting the port was 134 tons. In 1843, 206 tons.

I will now state very shortly the nature of Mr. Murray's plan for remedying the evils described, referring to his Report and evidence for further details.

Its main feature I consider to be keeping the water at all times up to half-tide level, or 7 feet above low-water mark, thus giving an additional 7 feet of water, independently of dredging, by which means vessels of moderate draught would be always afloat.

This he proposes to effect by placing across and nearly in the middle of the river, two pairs of skeleton gates, each pair 80 feet in width, for the general passage of vessels. The distance between these gates and the south shore to be 140 feet, in which space a waste weir and sluices are to be erected, for passing the tidal water and land flood. Between the gates and the north shore, a tidal basin of nearly two acres, with gates at each end, is to be made a station for steam-tugs, and for locking vessels in and out of the harbour.

The nature and position of these works will be clearly understood by the accompanying sketch from Mr. Murray's plan:—the sill of the gates is to be 6 feet under the water of average spring tides; the tops of the gates and also that of the sluices and waste weir to be level with high water of ordinary spring tides. Mr. Murray has not yet decided on the particular kind of sluice; he proposes to adopt that which will work most easily and press the water most readily. I may here state that what is here meant by "skeleton gates" are gates of which the ribs or principal framing only is fixed, the skin or planking being in pieces removable at pleasure. These gates are also proposed to be made in at least two heights, the upper of which is to be about 7 feet 6 inches in depth, to open independently of the under ones.

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It is evident that the effect of these gates and sluices, when closed, will be to keep the water in the harbour up to the level of high water. Their action will be best understood by explaining the process during one tide, beginning at low water. Supposing there is no fresh in the river, all the planking or moveable pieces of the gates in their places, the main gates and one pair of the gates of the tidal basin closed. The water on the upper side of the gates, or in the harbour, must be supposed at the same time to be penned up 7 feet above low-water mark, the excess or "following water" of the river then passing out through a sluice, or over the lower division of the gates.

Now, as soon as the tide has risen to 7 feet (the supposed level of the water in the harbour), it will force open the gates, after which ships may pass in freely with the flowing tide, either through the main gates or through the tidal basin, till the time of the high water. Then the tide will begin to ebb out, the gates being kept open for vessels passing out, until the water sinks to the original level of 7 feet above low water, when all the gates will be closed. The locking in or out of the tidal basin may, however, continue even until and after low water, for small craft. It is evident that at this period, whilst the tide outside the gates is ebbing away, the water inside will be rising by the rising of the river; or the remaining portion of the tidal water coming down, which it is supposed will be sufficient again to fill the harbour to the level of high water in about an hour and a half or two hours, at which time, say about an hour and a half before low water, the sluices will be opened, and the collected 7 feet of water will be allowed to pass through them, reducing the harbour to the state we at first found it. Mr. Murray considers that this quantity of water passing out with great velocity at near low water "will form an immense scouring power, deepening the channel, and lowering the bar at the north of the harbour."

A considerable piece of the flat low ground (the Potato Garth), between the sluices and the entrance piers, is to be excavated to 14 feet under low water, and then covered with 4 feet in depth of large stones, intermixed with clay and gravel, and levelled where necessary, and the space between the lateral walls is to be paved with large blocks, to protect the scour of the sluicing.

A triangular piece of ground on the south side of the river, below the entrance to the proposed sluices, is to be excavated to form a "trap" for the seas which it is supposed will extend themselves to this space, and the water will thus be stilled before approaching the gates; and for the same purpose it is intended to take down the wall in front of the Potato Garth on the west side of Monkweamouth Dock entrance, and to substitute open framing upon which seas may break and expend themselves; also to make another breakwater screen, if required, on the south side.

The works, exclusive of purchases and compensations, are estimated at 60,000*l*.

This abridged description of the proposed plans, and of the anticipated advantages, is not intended to supersede a reference to Mr. Murray's detailed and very explanatory Report, but only to bring the main points to your recollection. The Commissioners have engaged Mr. Mylne and Mr. Rendel; and it will be seen by a reference to Mr. Murray's evidence, that these gentlemen have verbally approved the principals of his plan, but have not yet reported as to the details.

Mr. Buddle and Mr. Nicholas Wood, both of the highest character and standing as mining engineers, spoke to the present inconveniences of the harbour, and the good that would accrue by keeping the ships afloat, but did not pretend to give any decided engineering opinion on the means by which this object was to be accomplished, and the same may be said of many of the ship-owners and others who are favourable to an improvement.

The argument in favour of the scheme, and replies to objections that Mr. Murroy anticipates, are so fully set forth in his Report and evidence, that I think it unnecessary to trouble you by repeating them. I also beg to refer you to the ship-owners and pilots who are, for the reasons they state, opposed to the plan. I have also attached to the evidence a copy of a Report, and some memoranda, from Mr. Leather, an engineer of eminence and experience in rivers and harbours.

Having well considered the subject and the different Reports and documents I have had access to, I must say, that the balance of my opinion is decidedly against the plan. It is ingenious, and for a river harbour of less magnitude, and less exposed to land-floods and to ice, might be applicable; but for the river Wear, at Sunderland, I think the difficulties and dangers have not been sufficiently estimated, and that when fairly viewed, they are such as to render the experiment (for such it may be called) unadvisable and dangerous.

Of the reasons for this opinion, none is stronger than the danger from ice, which comes down in great quantity and with great velocity. When it reaches the harbour, and the vessels lying therein stop its progress to the sea, it collects, is then carried back by the flowing tide, when it meets the descending ice, which increases its volume and thickness, and if at this time a sudden thaw brings down a heavy land-flood, the accumulated mass of ice returns down with a force that carries all before it. I have before referred to an instance of this in 1841.

The solid mass is stated to have quite filled the river for upwards of a mile in length, and then to have come down with a power that forced ships and keels from their stations, driving them against each other, and carrying some out to sea. This was an extraordinary case, but there is no security that it may not happen again, and cases of less magnitude are not unfrequent. Now I cannot but agree to an extent with the witnesses, who consider that in such circumstances the gate and sluices would be a dangerous obstruction, that there might be a great difficulty in opening or shutting them at the time, and that they might not resist the impetus of such a moving mass. Could the proper workings of three pairs of large gates, and a line of sluices 120 feet long, be depended upon at such a time? I fear not. It is proper to state that Mr. Murray thinks the ice may be brought gradually down into the impounded water, the area of which will be increased by the force, and that the ice will be spread over the salt grasses and wide places, where it may ground and melt, without coming into the harbour at all. Partially this may be the case, but, as a reply to the objection, I do not agree with him: I think that he quite undervalues the strength of his enemy.

A second and partly valid objection is the difficulty the works will present to the entrance and exit of large fleets of vessels, which sometimes amount to upwards of 100 sail, all pressing to get in or out during one tide. Take, first, light vessels entering with an easterly (fair) wind; these come in with the tide, and sail as soon as there is water upon the bar; those that are first, go as high up the harbour as they can with safety, to make way for the others, checking their way by ropes to other vessels, or by beaching on the Ham Sands; the scramble and confusion this must cause in a harbour already pretty full, and with a strong wind and tide, may be imagined; damage is occasionally done, and mostly happens between the present entrance piers and Folly Point, near which the works are proposed. When a vessel, from missing her steerage or otherwise, is obliged to drop her anchor, she swings round, stops those following immediately astern; others follow, and a crowd of vessels are huddled together: cases of

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damage in this way are frequent and sometimes heavy, though not generally so, the upper works chiefly suffering. After the gates are erected, dropping another anchor opposite the Potato Garth, which is now rather the exception, will in all cases of strong wind be the rule, as it would, I conceive, be dangerous to sail up to and through the gates with a strong tide, increased as it would be by passing between the lateral walls, so that the helm would be of little service, and there would be a danger of getting athwart the piers or gates, and damaging the vessels or works. This mode of dropping, by dropping anchor, was agreed to by witnesses on both sides; but then there was a great difference of opinion as to the number of vessels that might pass in one tide, each going through the operation of dropping anchor, sweeping round, getting the anchor, and warping through the gates; small vessels in moderate weather might, early in the tide, be locked through the tidal basin, but larger vessels would have to pass through the great gates in the way described; and I think that anything like the number, or even half the number (100 to 150 I have named), could not get through in one tide. There is also the liability, in a fleet of vessels entering in a strong tide and easterly gale, that some accident may occur, by which they may come against the works before their way is checked, or even before the gates are opened (there being 13 feet at the entrance at the time), and consequent damage to the works and vessels ensuing. Nor do I think this liability lessened by the stones with which Mr. Murray proposes to cover the ground, which may be suited for resisting the scour of the sluices, but are not favourable to the anchors holding, and which the anchors would be very apt to disturb, or they might make the anchor difficult to get.

Then, as to laden ships going out, these must get over the bar before high water, and the scramble is described as being equally great as in entering—all, so soon as there is water, being desirous of getting away. If the bar and the flow be good, numbers get away by half-flood, which is an advantage to them, and clears the way for others. As the gates would not be opened till half-flood, vessels could not move out of the harbour so early as they now do, which would be an inconvenience and stoppage, but not, I think, so great, nor likely to be so mischievous, as that of ships entering.

3rd. Mr. Murray considers that there will be little danger of sand collecting behind the gates, as they will be closed when sluicing. Now even supposing the strong power of the sluices be sufficient for a powerful scour upon the bar upwards of half a mile from them, I think the sluices alone would not pass the water of land-floods, which sometimes come down with great force, filling the whole area, and overpowering the tidal flow even at high water. Then all the gates and sluices must, I think, be open, when the sand brought down by the floods may tend to accumulate behind the gates. Mr. Murray would contrive means of lessening the probability of his gates being prevented from shutting or opening from this cause; but it must be admitted, that what with ships, sand, and ice, an accident to some of the sluices or gates, which would for a time prevent their working, is not improbable, and that if thus or otherwise the water be suddenly let out, and the ships grounded, the damage to them would be greater than at present, as they would not be prepared for grounding, and as ships of a large size, and of a build less suited for taking the ground, would come in expecting to be kept afloat.

I have stated that the "following" river water is chiefly the resource for restoring the harbour to high-water level in two hours after the gates are shut at half-ebb. I find that in droughts this will not be nearly sufficient, so that even if Mr. Murray be correct in supposing the water between half-tide level and the top of the gates, when let out through the sluices, to be sufficient for keeping down the bar, which admits of serious doubts, it does not appear that a sufficient supply will be had in dry weather for the purpose, when the cubic contents of the pool to be filled are several times that of the river supply.

The tidal water in the upper part of its flow will be drawn downwards and assist, but will do little towards supplying the deficiency.

The last observation is applicable also to the space below the sluices, including that portion of the Potato Garth which is to be deepened. I think Mr. Murray overrates his scouring power when he supposes that it will keep deep water over a space, the sectional area of which is seven times the area of the sluices, or even if the quantity were by calculation sufficient to give velocity, that it would be uniform over so great a space; the scour in lieu of the sluices would be great at the sides and end of this direct line; there would be eddies, and consequently irregularity of depth, requiring frequent dredging.

When it is considered that the site of the gates is within half a mile of the pier heads in a straight course east and west, and that the width at high water is nowhere less than 300 feet, the swell at present must be very considerable, and the evidence describes it being so, but it takes place after half-flood, when the gates will be open. The means proposed by Mr. Murray, which I have described, would lessen this; but I agree that there would be a rebound from the solid parts of the works, and that there would occasionally be such a swell in the passage up to the gates as would be sufficient to injure vessels and the works if they come in contact.

If the measure were likely to be attended with the success its promoters anticipate, I consider that the value of the wharfage and other property on the banks would be improved, although there might be immediate expense and future difficulty in repairing the wharf walls, many of which are in a miserable state, having been founded before the harbour was deepened. It would be otherwise with the graving and floating-docks, and the repairing ways or hards, and some property on the Monkwearmouth side, which would be injured; when, however, the parties have legal or equitable rights, these damages would be matters for compensation, and should not prevent a great public good.

I think the works would cause a deposit in the harbour, therefore in this respect I differ from Mr. Murray, but it is proper to add that deposit is generally a consequence of any artificial enlargement in the channel of a river; that it takes place to an extent in the harbour of Sunderland now, owing to the artificial deepening, and has to be removed by dredging. The quantity and expense of this would, however, be increased, by penning the water, and consequently lessening the velocity; but neither would this alone, in my opinion, be a reason for public opposition, were the measure otherwise safe and judicious.

It will be seen, by reference to the evidence, that what Mr. Murray estimates at 60,000*l.*; Mr. Brooks puts at 200,000*l*; the last is little more than a guess, therefore Mr. Murray is in this respect more to be depended on. I confess, however, that 60,000*l.* is much under what I should have supposed, for the works will be very difficult of execution from the nature of the foundation, and more so from the damage to which, during their progress, the dams and works will be exposed. To execute them properly, without obstructing the passage of shipping, will, to say the least, require much management, and be attended with delay and expense.

I have, &c.,
JAMES WALKER.

To the Secretary of the Admiralty.

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No. 305.

Report of WILLIAM CHADWELL MYLNE, Esq., C.E., *on Mr. Murray's proposed Floating Dock.*

New River Head, London. April 29th, 1843.

GENTLEMEN,

Having received instructions through Mr. Murray, your engineer, to report, in conjunction with Mr. Rendel, upon a plan for effecting certain improvements in the harbour of Sunderland, and having been unable, from the pressure of business, to make my survey at the period at which Mr. Rendel could attend, I proceeded on the 3rd of the present month to survey the same, attended by your engineer, and to examine the several plans prepared by him for the proposed works, copies of which have been transmitted to me.

During this survey, I was made acquainted with the objections raised against the projected scheme, particularly as to its effect to seaward of the intended dam and gates; also on the general drainage of the river, and the action of the water on the wharfs of the river, where it is intended to be stalled up to the half-tide level of a spring tide.

Many fears must, no doubt, suggest themselves on the introduction of a scheme upon so large a scale, which has never before been executed in this country, although works corresponding in their object, and in the main features of the design, are in perfect operation on the Continent, under far less favourable circumstances.

In consequence of the numerous rivers which exist, and are supplied by the aggregate quantity of rain falling abundantly on this island, we have rarely been called upon professionally to construct harbours where a sufficient natural back-water does not exist.

The harbours on the eastern coast of Kent and Sussex have called forth great consideration, and also large expenditure; but their main objects have been that of refuge during bad weather for commercial vessels, as also for ships of war.

It is perfectly evident, that where a commanding back-water does not exist, and the shores, like those of Kent, Sussex, and Norfolk, be loaded with travelling beach, or where much alluvial soil is brought down the rivers from above, the gradual decay of every harbour so circumstanced must inevitably follow, unless artificial means be applied either by scours or by the application of dredging.

The expense of the necessary works for creating such artificial power, for the maintenance of harbours, has generally been found in this country greater than the value of their locality; and the decay of those, where such artificial means have been adopted (several of which we have on record), has no doubt taken place from the circumstance of a sufficient amount not having been laid out to effect the required scour, and not from any defect in the mode adopted.

The silting up of the river Dee, near Chester, is a strong instance of the operation of nature, where the back-water is insufficient. Wells Harbour is another instance. Wisbeach, the Yare, and the Clyde were in a similar state of decay, until reclaimed by artificial works. The ancient Bay of Lowestoft has been gradually reduced. The harbour of Rye, and various others, exemplify this principle.

There are some few in England almost entirely maintained by artificial means alone, viz., Bridport, Ramsgate, Hartlepool, and Dover.

On the other hand, when we inspect the adjoining coast of France, Belgium, and Holland, we have the most striking instances of what can be effected by art. Here necessity has led to the introduction of works which answer most efficiently the objects desired, viz.: that of scouring away the bar, and in maintaining a sufficient depth of water within the port; many of these being constructed with a very small supply of fresh water, and others depending wholly upon artificial tidal reservoirs for the scouring power, viz.:—Cherbourg, Havre, Fecamp, St Valery, Dieppe, Boulogne, Calais, Dunkirk, Gravelines, Ostend, Flushing, and Hellevoetsluis.

If, therefore, such effects are in actual operation at the ports above mentioned, from causes so well understood, surely no other argument is required to support their application in the present instance than to show the value of maintaining the locality of Sunderland as a port, and that the means proposed to be adopted there, although varying somewhat by impounding the water at half tide within the river, yet corresponds sufficiently to ensure a beneficial result from the proposed works, on the principles established in the ports above referred to.

It is hardly necessary for me to state, that great competition has existed of late years in the coal trade; that it has lowered the price of that article in the London market, and that the shipments, through the means employed, have been fully equal to the demand of the increased population; to effect this, very large sums of money have been invested in the formation of railways leading to the port of Sunderland, and in the erection of new staiths and machinery on the banks of the river Wear; and that unless increased facilities are afforded for the shipment of the coals with greater convenience, and in vessels of larger tonnage, much private, as well as public, injury must ensue by the consequent migration of the trade to other ports, to which the ship-building interests will also be transferred, to the great injury of the port and town of Sunderland.

The particular feature of the proposed scheme consists in its impounding the lower portion of the river, for six hours, to the depth of a half spring tide. It will thus form a dock within which that class of shipping resorting to the port will be enabled to receive their cargoes while afloat at any period of the day, the previous portion of the tides being appropriated to the passage of the homeward and outward-bound ships through the navigable river gates.

By this operation the bar and the channel, to seaward of the gates, will be deprived of a portion of its scouring back-water to such an amount as will be impounded in the river after the gates are closed, amounting to about 20,000,000 cubic feet.

To compensate for this loss, a large portion of the tidal water having passed up for the distance of nine miles, will not have had time to have found its way back before the closing of the gates will take place; this will, as a matter of course, be enclosed above the dam, and from levels taken simultaneously at different points on the river, will amount, together with the current flow of the river, to about 15,000,000. This body of water will be available for sluicing purposes, in the usual way; and from its increased current being discharged under a greater head, will operate most forcibly, and produce a greater depth of water on the bar.

It is an admitted fact, that where the velocity is doubled, the effect of the scouring power will be quadrupled; it therefore follows that a much greater force will result from the discharge of the smaller quantity under an increased head, in a less period of time, than is now derived from the flow of the larger amount.

As regards the various objections which have been raised, I see little ground for their existence. A work, such as is now proposed, cannot be carried out without interfering in some degree with private in-

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terest, and each individual will consider himself specially aggrieved; but from the general arrangement adopted, and the natural form of the shores, I cannot conceive that any injury will be occasioned by the increased level of the water during floods, which can only occur under the peculiar circumstance of a fresh taking place at the period of the equinoctial spring tides; but this, with good management, would produce no material injury, situated as the property generally is above the range of such tides.

I should here observe, that several of the ship-building slips will, no doubt, be affected, and that pumping engines must be erected, to throw the impounded water out of them after the vessels have been docked. These are but small inconveniences, when compared with the great advantages to be obtained.

As to the possibility of the river silting up above the dam, it is wholly improbable, as the navigable river gates are to remain open for six hours during each tide, thus permitting the scouring power of the tide to exert its whole force on the bed of the river for that period.

This will effectually remove all accumulations that may take place during the intervals at which they remain closed, such accumulations being considerably diminished by the gates remaining closed during the first quarter's flood; it being a well-known fact, that the greater mass of silt is brought into the harbour by the indraught of the tide.

The artificial scour outwards may also be occasionally increased, when the diminished traffic in the port will admit of the navigable gates being shut at an earlier period, thus increasing the quantity and force of the discharging waters.

As regards its influence on the lower portion of the harbour, I cannot imagine that the dam will interfere with the customary usages thereof, for the larger-classed vessels cannot enter the port until the tide has acquired full 10ft. 6in. over the bar; about which period it will be level with the impounded water above; the gates will then open, and the flood-tide will continue as heretofore.

The openings through the dam being proposed to be made fully equal to the sectional area of the river, above and below its situation, no increased velocity will be produced; but as the navigable river gates, for the use of the shipping, are narrower than the river, some little delay may be supposed to be occasioned in the passing of the vessels; but as one opening is to be appropriated to the vessels departing from the harbour, and the other to vessels entering, no interference with each other can take place, as is frequently the case at present; and, at all events, no serious inconvenience can occur, as there will be ample time for the passage of all the shipping before the gates are again closed; and indeed, the smaller craft will be passed through the tidal basin after the navigable river gates have been shut.

The width proposed for the openings of these navigable gates being 80 feet each, will do away with all fear of vessels being injured, or blocking up the passage.

As to the effect and mode of controlling the scour, the examples on the French coast, and in your immediate neighbourhood at Hartlepool, are such as sufficiently to negative all apprehension of failure on these points, provided a sound and hard floor be laid for a short distance below the scouring sluices, from which it will be directed, through a channel on the bar below.

The effect of the swell upon the large navigable gates at the dam, during heavy gales from the eastward, will no doubt be considerable in the existing state of the lower harbour, and measures must be taken to correct the evil effect during stormy weather.

There may be various opinions upon the best mode of effecting this; but it appears to me, if a space of several acres was formed, by throwing back the western end of the south pier, and excavating a portion of the land in your possession, part of which is occupied by your yards, &c., and other parts now lying waste, the swell would, by such means, be intercepted before it reached the upper coble slip; and it might also be desirable to increase the head of the south pier, extending it northward, thus moderately reducing the entrance; by this, the waves which hug this pier would be much reduced, and ultimately destroyed in the excavated portion above recommended; and on the north side it would be so much broken by forming more openings in the existing carcases, through which it would be discharged upon the Potato Garth, that little or nothing of its effects could then be felt in the river above.

It is to be observed, that the lowest moorings are situated about 150 yards eastward of the navigable gates, and it is below these moorings where, during gales, vessels bring up, either by beaching upon the Ham Sands, and by passing up the harbour, or by dropping their anchors before they reach the Ham, and swing round by the tide; ropes are then run ashore, or to the vessels in the tiers, and their anchors being weighed, they are thus checked, and either drifted into the harbour, or taken away by steam-tugs. It thus appears to me that the position of the proposed works will not interfere with the customary operation exercised by the larger class vessels, while the earlier admission of the smaller craft will be under more favourable circumstances than at present, from the water in the harbour being comparatively freed from indraught. Still further advantages may be given to the larger vessels, by extending the beaching ground on the north side, and also on the south, and excavating the Potato Garth, so as to give an extent of deep water for swinging room in the outer harbour, far beyond the wants of the port.

Another objection has been raised to the necessary expenditure on those ruinous wharf walls situated above the proposed dam, which at this time are dilapidated, and only serve the purpose of the present shore, and are under constant reparation; but it is well known that a permanent work is ultimately the cheapest, and the impounded water must tend to support the weight of the material employed for the protection of the shore, and also of the bank itself.

Four quarterly periods are mentioned in the bill, of six days each, for the purpose of repairs; but this may be extended as the convenience of the inhabitants shall demand.

The great improvement in the value of the banks of the river, which must inevitably follow, when appropriated by the proposed works, as quays for shipments, with deep water in front, is such as to require from their proprietors rather the support of the measure than opposition.

Attention will be required during the discharge of those freshes, which take place when the breaking up of the ice, after a continued frost, is attended with heavy rains; these occurrences are rare, but their effects material.

On such occasions great injury to the shipping is at present sustained, from their taking the ground at low water, at which time should the fresh descend, its velocity is increased by the great declivity towards the sea, and also from the reduced sectional area of the river during the last quarter's ebb. Thus the descending torrent, together with the buoyant ice, is forced against the shipping while aground, causing infinite injury, and driving them from their moorings; so soon as the swell raised by their obstruction impounds sufficient to set them afloat, they are consequently forced against each other, and in some instances, as in 1841, carried out to sea.

Much of this inconvenience will however be removed by the vessels being always kept afloat, and

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from there being a greater sectional area in the upper harbour for the passage of the ice and water to seaward.

Great attention must at this time be paid to the sluicing gates, to give free vent to the flood, which, if done with care, will prevent all obstruction.

Having thus treated on all the points which appear to me essential in the present state of the inquiry, I beg leave to subscribe myself,

Yours, &c.,

To the Commissioners of the River Wear. WILLIAM CHADWELL MYLNE.

No. 306.

Rendel, on Murray's proposed Floating Harbour.

No. 306.

Report of J. M. RENDEL, Esq., *on Mr. Murray's proposed Floating Harbour at Sunderland.*

GENTLEMEN, 8, *Great George Street, Westminster, 9th May,* 1843.

Your wishes that I should be consulted by Mr. Murray (your engineer), on the subject of his plan for improving the River Wear, by a half-tide dam and gates, built across the channel from Thornhill's Quay to the Ham Sands, were communicated to me on the 13th of March, and on the 17th and following days I was engaged at Sunderland, in company with Mr. Murray, making such examination of the harbour and river as I deemed a necessary preparative for the required duty. Since my return from Sunderland, I have had several meetings with Mr. Mylne and Mr. Murray in London, and after a most careful investigation of the plan, I fully concurred in opinion with those gentlemen, that its principle is compatible with the character of the river and harbour, and admirably adapted to the wants of the existing interests of the port, interests so vast as to command the first consideration in any plan for the improvement of the port that can be deemed feasible. The strongly-expressed opinion in favour of the principle of Mr. Murray's plan appeared, I presume, sufficient to render unimportant for the time any difference of opinion as to its details, but in the state of abeyance in which the measure is now placed by the report of Mr. Walker, and the consequent intimation of the Lords Commissioners of the Admiralty, that they object to the present plan, the alterations in its details, which I am now fully prepared to recommend, should, it is thought, be submitted to their Lordships, and in consequence I now beg to hand you a design or modification of Mr. Murray's plan, which I hope may be made intelligible by the following explanatory report, a comparison of the accompanying design with Mr. Murray's will fully explain the difference in the details of the two plans:—

1st. I propose to make the outer harbour nearly double the size shown on Mr. Murray's plan, by additions on each side. On the south, by setting back the inner half of the present piers in a southerly direction, extending it to the cliffs, and by the excavation of the ground in front of your workshops and engine-house; on the north side, by the excavation of the Potato Garth, including the removal of the old breakwater and the western wall of the Wearmouth Dock Basin.

2nd. I propose the extension of the float or impounded river along the north shore, to the Wearmouth Dock, terminating with scouring sluices to the west of its entrance basin, and having communication with it (the Wearmouth Dock) by gates of the same width as those at its entrance; the higher or western end of this extension of the float to be made at least 250 feet wide, and its postern end 200 feet, its south side forming a weir of upwards of 1100 feet long, raised to the height of the impounded water surmounted with wash boards, a gangway above the level of high water, and provided with mooring-posts and rings, and its north side protected with a wall, containing ship-ways and all other conveniences for the ship-builders' yards, which now line this shore; and—

3rd. I propose to construct a dam across the present harbour, immediately below instead of above the Ham Sands, with two pairs of gates on the south side of the harbour, each 60 feet wide, and one pair of the same width, and a lock, on the north side, the intermediate or mid-channel space being filled up with scouring sluices.

By this arrangement the outer harbour will be increased from about 20 to upwards of 40 acres' area, the additions being such that vessels may bring up by their anchors on either side of the channel leading to the gates of the inner harbour; or, by grounding on a roomy and convenient beach, this anchorage-part of the harbour will be five times wider than the channel between the entrance piers, and, the heavy in-run of the sea in easterly winds will thus have room to disperse itself. The flood-waters of the river and sea will have free vent down the extended float, and over the very long and capacious weir, forming its south side. The flood-tide, when it rises to the level of the dam, will pass over this extended weir and into the float, without rush or injurious current. The Wearmouth basin and dock will be made an important part of the improved harbour; the property between it and the dam will participate in all the advantages conferred by the float. The power of sluicing and maintaining the depth of the outer harbour and channel leading from it to the bar, will be greatly increased; supposing one pair of gates to be under repair, there will still be two pairs available for shipping; and, lastly, the dam and gates will admit of more easy construction, and the works cause less obstruction to the business of the port during their progress.

There is doubtless room for a difference of opinion as to the extent to which the south pier should be removed and set back: mine is, that it should not be less than shown in the accompanying design, deeming the difference of the expense between such a removal and any admissible minor one of little importance in comparison with the advantages of increased capacity and consequent quiet with the greater extent of the breaches in this part of the harbour.

Opinions may also differ as to the best position for the dam and gates: my own is, that those works cannot be too near the widened part of the harbour, consequently, if it should be decided that the site I have adopted is too low there, I should say, the proposed widening of the outer harbour should follow the higher position of the dam and gates; this would involve the removal of additional property on each side of the harbour, and would be attended with the loss of the rock foundation, which the gates on the south side of the dam, as also the sluices, have the advantages of as now designed. In regard to the width of the float leading to the weir, I beg to remark that I consider what I have before stated to be the least that is admissible.

In explanation of the plan, I have only further to observe that I contemplate the excavation of the Potato Garth to the depth of the bar, to which depth it would be easily maintained by the water discharged over the weir, which is co-extensive.

The outer harbour enlarged, as shown on the accompanying plan, would accommodate, without crowd or obstruction to the channel leading to the gates, at least sixty vessels, assuming that some brought up by their anchors. whilst others beached on the new shore opposite the engineer's house, and others on the bank to be formed on the north side of the gates, at the commencement of the weir: such a capacity in the outer harbour, and the absence of a strong current or of broken water through the gates, which the great length of the weir will secure both on the flood and ebb-tide, will, I am convinced, prevent all dangers or difficulty in bringing up in the outer harbour, or in passing to and from the inner harbour or float.

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In reference to the principle of penning the water in the way proposed, I would remark, that I do not think the river of sufficient magnitude to make its fresh water deposits a matter of serious apprehension, particularly as all accumulations of that kind will take place at the head of the float near Hilton, where it can be removed at a trifling cost.

Again, as to the effect on the bar at the harbour's mouth, it must not be overlooked, that by properly-contrived and well-applied sluices, the retained water to be discharged during the hour or hour-and-a-half of lowest water on the bar, will give a greater scouring power than the last three hours' natural ebb of which it will be deprived: the difference in favour of the former is matter for calculation, and has been made by Mr. Murray. Also, it should be remarked, that at present the indraught of the first half of the flood in spring-tides is quite sufficient to charge the water with much sand, and cause its deposit in the higher and wider parts of the harbour. This indraught will not exist after the proposed works are executed, for the first half of the flood, which will exclude much of the matter that now accumulates in the harbour, causing a necessity for constant dredging, will lessen the liability of accumulations in the outer harbour, which will, in all probability, have but small occasion for the use of the dredging-vessel.

Mr. Mylne, in his clear and very explanatory Report, has gone so fully into the many arguments that can be advanced in favour of the principle and plan that it becomes unnecessary for me to say any more than that I agree with him therein.

A minute estimate of the probable cost of executing this plan has not been gone into, but if you wish it the exact quantities of work shall be computed, which being charged at the same rate as in Mr. Murray's estimate, would of course give the comparative cost of the two plans. I have compared the quantities of work in both in a general way, and find that, exclusive of setting back the south pier and the gates of communication between the float and the Wearmouth Dock, the quantities of work in the two plans very nearly agree, and as their relative difficulties of execution are certainly not unfavourable to the modified plan, its whole cost cannot be more than 30,000*l*. in excess of Mr. Murray's plan, or say 90,000*l*. exclusive of compensation, the claims for which would certainly be reduced in number, and still more in amount by the benefits which the modified plan could not fail to confer on the dock and the property from thence to the Ham Sand.

I have, &c.,
JAMES M. RENDEL.

To the Commissioners of the River Wear and Port of Sunderland.

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No. 307.
Murray's Second Report on the Floating Dock.

Second Report of JOHN MURRAY, Esq., C.E., *on the proposed Floating Docks.*

No. 3, Spring Gardens, London, 8th May, 1843.

GENTLEMEN,

Having been furnished with a copy of Mr. Walker's Report of the 27th of April last, giving his opinion of the plan now before Parliament, for the improvement of the port of Sunderland, I consider it due to myself and the situation I hold, to endeavour to correct some of the representations stated by Mr. Walker, arising out of the conflicting evidence brought before him during his investigation.

The disadvantages of the insufficient depth of water in the harbour are universally acknowledged; but the Report states that Lord Durham and the Hetton Company have improved their shipping places above the bridge at considerable cost, and at those places there is sufficient depth at low water close to the wharf. The shipping berths belonging to the Earl of Durham are the best in the harbour, and the three highest were deepened, at considerable cost, by excavating the rocks to the depth of twelve feet below low water. under my recommendation and superintendence. The Hetton Company's lowest shipping berth was similarly improved, but the others very frequently silt up, and are sometimes nearly dry at low water. Mr. Pemberton's shipping berths, on the opposite side. are even in a worse position. One of the dredging-machines is generally employed above the bridge for maintaining a depth of water in these different berths. The shipping places belonging to the Durham and Sunderland Railway Company have from four to ten feet at low water at spring tides. This depth has been obtained at considerable cost, by the removal of a stratum of strong marl, two to three feet in thickness, resting on the limestone rock; and therefore it is impossible to excavate them deeper than they now are, without incurring a large expenditure.

According to my observations for the last ten years, the ice, as stated in Mr. Walker's Report, neither comes down the river Wear "in great quantity," nor "with great velocity," except on very extraordinary occasions, which may possibly happen once in 20 or 30 years. Generally speaking, it comes away very easily and in small pieces, through the harbour of Sunderland, which is caused by a large body of tide water breaking up, and carrying it to sea during the latter part of the ebb. The river below Hylton is scarcely ever frozen, and in very severe winters, only for a short distance below that place. Between Hylton and Biddick, which is within the influence of the tidal waters, the ice is broken up, generally speaking, before the river is free above, and is brought down by the ebbing waters without difficulty. The Durham ice, as it is called, always passes through the harbour of Sunderland very much broken, and does no injury whatever to the shipping. This broken ice, from the higher parts of the river, before it can get to sea, may meet with the flood-tide, and be carried back by it some little distance; but it does not accumulate to any mass, nor does it freeze again to any extent, when within the influence of the tide.

Even at the breaking up of the ice in January, 1841, which was an extraordinary occasion, the mass of ice coming down the river grounded on the shallows at Pallion, and accumulated there, impeding the descending waters until they increased to such a height as to float off the ice, and carry it downwards. This never would have happened had the ice not taken the ground; and it is proposed by the projected works, to impound the water so as to have five feet upon the shoals at Pallion, which will prevent the ice from stopping there. In place of coming down the river, therefore, with the velocity due to the current, from half-ebb to low water, the ice will be floated into the impounded water standing nearly at

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a dead level, so that its impetus will be completely lost before it can reach the shipping, which, by lying afloat, will allow it to pass beneath them, and spread itself over a wider surface. There is a greater likelihood, also, of the ice distributing itself over the salt grasses of the river, above Pallion, caused by the impounded water, than it can do in the present confined low-water channel.

Mr. Walker conceives that the pressure against the dam and gates would not resist the impetus of the moving mass of ice and water. If the works be made strong enough to resist the pressure of a perpendicular height of water during the highest tides, accompanied by land-floods, surely the ice, which is a floating body, cannot add anything to that pressure, excepting by the impetus with which it moves; and I have endeavoured to show that the force of the floating mass will be lost before it can arrive even at the shipping in the higher parts of the harbour, and consequently at a distance from the projected works. The great width of the openings in the dam are fully equal to pass the broken ice under the circumstances described.

Mr. Walker's second objection is, the difficulty the works will present to the entrance and exit of large fleets of vessels. The crowded state sometimes of the lower part of the harbour, where the shipping all wish to resort, for readiness to proceed to sea, make the navigable passage very contracted at present, and the works in my opinion are calculated to effect an improvement. Few harbours, at their entrance, have the means of increasing their capability for the reception of a large fleet of vessels like that of Sunderland. Here, at the distance of 350 yards from the eastern extremity of the entrance piers, the river expands, and takes the remarkable formation of the Potato Garth, or shingle bed, now dry at low water, while at the top of the tide it assumes a semicircular form, with a radius of about 80 feet, thus presenting an area of sixteen acres between the Wearmouth Dock entrance and the Ham Sands north of the present low-water channel. This area has always been considered of great importance to the harbour, for tranquillizing the swell of the sea in stormy weather. A large part of this shoal ground, which is entirely formed of gravel, might easily be removed by dredging, so as to form a deep and capacious harbour, for the reception of a large number of light vessels that sometimes enter the harbour in one tide. If beaching around be made to skirt this deep water on its northern side, as far westward as the Ham Sand, vessels may be brought up without dropping their anchors, and be then warped through the navigable gates, or be speedily towed up the harbour, by steam-tugs, to make room for others to enter, which would, in my opinion, afford ample facility for all the purposes of the port, and be the means of preventing much of the damage and confusion which now occur, when a number of vessels get huddled together, and block up the present confined low-water channel. I differ, therefore, from Mr. Walker in supposing that vessels dropping anchor opposite to the Potato Garth would, in cases of strong wind, be the rule adopted. I conceive that many of them, being homeward-bound vessels in ballast, would be brought up by beaching, which is frequently done at present, with no injury, on a floating tide, and with less inconvenience than dropping anchor. Steam-tugs, which are much used at Sunderland, would then take a great number of vessels up the harbour, through the navigable gates, (where the current, it must be remembered, would be no greater than at present,) more easily and with less detention than through the confined passage between the ships as they now lie at their moorings. I annex a plan of part of the harbour connected with this question, upon which are delineated the moorings that have been in use for many years, and the number of vessels which the harbour-master permits to lie in the situations specified. The works are also marked in red, on the same plan, to show the proposed altered state of things.

Mr. Walker mentions 13 feet as the depth of water at the entrance before the gates are opened. In this I think there must be some mistake, as there are four feet of water in the fair-way on the bar at low water of spring tides; and the rise of half-flood being seven feet three inches, makes only eleven feet three inches of water. Something more should be allowed for the send or swell of the sea, making barely depth enough on the bar for average class vessels, in ballast, at half-flood. Those entering with a strong tide, and easterly gale, would require 13 feet on the bar; and with that rise of tide the navigable gates would have been opened nearly an hour.

As to the ships departing from the harbour, there is no scramble, as described by Mr. Walker. Each generally is towed out, one after another, by steam-tugs. The smaller ships seldom leave till half-flood; but if inclined to do so earlier, they could do it through the tidal basin, while the large vessels now move out as early as they can to cross the bar with safety; those of the greatest draft remaining till nearly the time of high water.

The third objection of Mr. Walker is the danger of sand collecting behind the gates, and thus preventing them from opening or shutting. Culverts and other means were always intended to be adopted to provide for this exigency. It must be evident, that if the sectional area of all the proposed openings at the depth mentioned in my former Report be equal to the present sectional area of the river above as well as below where they are intended to be placed, they must pass the water of land-floods without obstruction; and as to the injury which the shipping may sustain by taking the ground in case of accidents to the gates and sluices, it is a probability to which all docks are liable: and in practice at Bristol, Liverpool, and other places, it seldom occurs. It is shown on the plan, that the tidal basin is intended to have an additional pair of gates, fronting inwards at the Folly Point, with the view of docking in it a few sharp-built vessels, in case of accidents, or at those periods of the year specified in the Bill, when the waters of the river are intended to be entirely run off. The Wearmouth Dock will also afford accommodation for vessels on such occasions.

I differ from Mr. Walker, who supposes that the "following" waters of the river would be the chief supply for sluicing purposes. By observations taken in different parts of the river on the state of the tide at the period of half-ebb, I find that about 33,000,000 cubic feet of tidal water are proposed to be impounded during ordinary spring tides. I further calculate, that with the "following" waters passing down the river in dry seasons, the quantity collected in two hours against the dam and gates available for sluicing purposes, is about 15,000,000 cubic feet. The last quantity being passed through sluices for the period of an hour below low water, under an average pressure of seven feet three inches, would create a velocity of the current through the present sectional area of the river, between the piers, at three miles an hour; and as the bed of that section, and the bar 300 yards beyond it, is composed of sand and gravel, it would be acted upon by such increased current, and deepened considerably.

It is also stated, that the swell or range of the sea in the present harbour would cause a rebound from the solid parts of the proposed works, which might be injurious. This may, in my opinion, be altogether prevented; for the sea at present hugs the north and south piers, according to the direction of the wind, leaving the middle of the river, opposite to the Potato Garth, comparatively smooth; and, therefore, by opening a considerable portion of the western end of the south pier, as mentioned in my former Report, and making (if it should be deemed necessary) what the French call a *clair voie*, the swell that now hugs it, and passes up the harbour, would be broken therein. If, on the other hand, the north pier,

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from the Wearmouth Dock entrance upwards, be made with open framework, and a portion of it be removed altogether, the waves will be lost by expanding on the Potato Garth.

Mr. Wolker is of opinion, that by penning the water, and consequently lessening the velocity, the deposit in the harbour would be increased. If the impounded waters were always to remain stationary, as in a wet dock, no doubt sediment would be formed, but the greatest part of the mud deposit would be brought in by the flood-tide. The land-water which passes through the pents of Dover harbour is trifling, and of a clear quality, even after rain; yet these receptacles are covered to some thickness with the finest mud. Seaham Harbour, in our own locality, through which no land-water is discharged, has much mud in the docks, which can only be brought there by the tidal waters.

If there were no sluices in the proposed dam, sediment might accumulate in time to its proper surface. Mill-dams placed directly across a river, with no contiguous draw gates, naturally cause it to silt up; but where the dams have sluices, even of a small area, and only occasionally opened, the bed is never raised above the sills of the gates. The in draught of the water to the sluices works upon the bottom, and sweeps all before it. Many cases might be adduced to show their tendency to deepen rather than to cause the bed of a river to silt up.

If alluvion be deposited higher up the river, it could be acted on by the principle of flushing. This method has been successfully practised by the Commissioners of Sewers of the Holborn and Finsbury district; and shows, on a small scale, what can be done on the Wear. By penning back the common run of water, and letting it off suddenly, an artificial fall is obtained, and consequent velocity of the current, which not only scours the sewer for a certain distance below the temporary dam, but removes all above it, within the influence of the penned-up water.

In my former Report it is stated, that the greatest portion of what is raised by the dredging-machines is sand, a very considerable quantity of which, with other matter held in suspension, is brought into the river by the first of the flood, which, by its gravity, rolling along the bottom, stirs up the light particles of sand, and carries them along with it, to form deposits on the returning ebb-tide. In corroboration of this, it is well known that the flood makes from the north, and sweeps along with it much sand and gravel. Every groyne or jetty that runs out from this shore at right angles with the line of coast collects it. The north pier itself acts like a groyne, and has been the means of forming that area of low sandy ground on which the Wearmouth Dock is now placed. The in-draught of the tide, when it sweeps round the north pier, naturally brings with it a quantity of sand and gravel: by shutting the proposed gates, much would be excluded from the harbour, as there would be little in-draught during the first half of the flood, and the greatest portion would be carried to the southward. The small quantity that may be deposited in the comparatively still deep water, below the proposed works, would be easily removed by constant sluicing and occasional dredging.

As regards the accuracy of the estimate, I have gone through it in a detailed form, with a contractor of great experience in works of a similar nature, who has completed many large contracts successfully, and is satisfied that the quantities are properly measured, that the prices are sufficient, both as to labour and materials, and that the works described in the plans can be executed in a sound, substantial, and workmanlike manner, for the sum of 60,000*l*.

I am, &c.,
JOHN MURRAY.

To the River Wear Commissioners.

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HARTLEPOOL.

Report of Captain SLATER, R.N., *on the Improvement of Hartlepool Harbour.*

Sunderland, 24th May, 1840.

SIR,

In compliance with directions from the Lords Commissioners of the Admiralty, contained in your letter of the 7th instant, "To repair to Hartlepool and there take means of examining the channel from the 'coffer dam' to the deep water in the bay, in order to ascertain how far the channel has been deepened and improved by the sluicing process and other works of the Dock and Railway Company, but distinguishing the works of that Company from those of the Hartlepool Pier Commissioners."

I have the honour to acquaint you that, in consequence of the unsuitableness of the weather for that purpose, I could not enter upon the required examination before the 16th instant.

On my arrival at Hartlepool on the 14th instant, my first step was to ascertain the line of demarcation between the "Dock Company's" limits and those of the "Pier and Port Commissioners," and on being referred to an Act of Parliament of Vic. 1, 1837, clause 10, I found that "an imaginary line drawn across from the town's wall of Hartlepool to the opposite shore, in the direction of the south edge of the existing portion of the coffer dam," was to be considered the boundary between the outer or Commissioners' Harbour, and the Inner Harbour belonging to the Hartlepool Dock and Railway Company. It is therefore apparent, that all the works without or to seaward of the coffer dam, viz., the cut from the coffer dam to the sea, the stone jetty, and the old pier, are under the jurisdiction and powers of the "Hartlepool Dock* and Railway Company." The works of the Pier and Port Commissioners are indicated by a blue line on the plans which accompany this Report.

My attention being next directed to the sluices (which are situated at the northern extremity of the Dock Company's tide harbour), I ascertained the following particulars, viz., that there are 18 apertures of 19 feet area, for the discharge of the waters of the Slake; that these apertures, being under average pressure of 10 feet, are capable of sending forth about 9000 tons of water per minute; and it being assumed that there is a mean depth of 3 feet at spring tides over the whole area of the Slake (viz., 118 acres), there will be at such periods 571,120 cubic yards, or 428,340 tons available for sluicing purposes.

In the course of my inquiries I was given to understand that the sluicing process had been employed at irregular periods only; that from the 16th of February, 1839, till the 7th of January, 1840, that operation had been performed but six times, viz., 16th February, once; 17th February, once; 29th June, once; 30th June, twice; and 7th January, once; and also, that the tide had not been allowed free ingress into the Slake, the sluices being too contracted to admit at spring tides the full amount of tidal water; and that, in consequence of certain alterations being made in the works

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* This should be "Hartlepool Pier Commissioners."

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adjacent to the sluices, the tidal water had at times been kept altogether out of the Slake. Under these circumstances, therefore, I might reasonably expect that the state of the channel from the coffer dam to the sea would be in the worst state possible.

On the 16th and 17th of this month I obtained (previous to sluicing) soundings in the cut and off the entrance, which are shown on plan No 2; and, when compared with the survey of 1838 (Plan No. 1), will point out the changes which have taken place during an interval of 18 months.

On the 17th, and immediately after having sounded the cut, the sluices were opened, and the same evening and following morning that operation was repeated; but in neither instance did the tide ebb out sufficiently to give full effect to the sluicing power, there being two feet water at the gauge above the zero of good tides; but nevertheless, the water was discharged through the cut into the bay at the rate of seven knots per hour; and, after leaving the cut, the surface current was observed to make a slight curve to the westward; and, at the distance of 2000 feet from the pier, it then took a more westerly course, having encountered the flood stream. (See Plan No. 5.)

On the 19th instant, being one day after the third sluicing, the space which had been examined on the 16th and 17th instant was re-sounded, and the depths laid down as expressed on Plan No. 3.

On each of the Plans which accompany this Report, a similar space enclosed by a red line has been allotted for the insertion of soundings, in order to make a comparison of the mean depth under different circumstances; thus, the mean depth of water in the cut and off the entrance was found to be as follows (for fuller details, see Plans 1, 2, and 3):—

IN THE CUT.	Feet.	OFF THE ENTRANCE.	Feet.
In November, 1833	4¾	In November, 1838	3½
In May, 1840, before sluicing . .	3½	In May, 1840, before sluicing . .	3
In May, 1840, after sluicing . .	4	In May, 1840, after sluicing . .	3½

And, with reference to the deeper water in the bay,—

	Feet.	
In 1838, the mean depth was found to be	7¾	See Plans 4 and 5.
In 1840	8	

The alterations which have taken place with respect to the bar from November, 1838, till May, 1840, appear as follows:—

In 1838, the bearing of the bar from the pier light .	S.W. ½ S. 750 feet.
In 1840, before sluicing	S.W. b. W. ½ W. 950 feet.
In 1840, after sluicing	S.W. b. W. ¼ W. 860 feet.

And the depths as under:—

	Feet.
In November, 1838	3½
In May, 1840, before sluicing	3
In May, 1840, after sluicing	2½

On comparing the depth on the bar in 1838 with that taken in May, 1840, before sluicing, I observe a decrease of six inches, and a still further decrease of the same amount after sluicing.

The depths and distances along the outer or sea margin of the bank are nearly the same in all cases.

Having given my best attention to the facts afforded by the examination just concluded, and having carefully considered the soundings both before and after sluicing, and compared them with my survey of 1838, I find the differences too trifling to merit attention except at the bar. *

In the foregoing remarks, I have shown that the sluices have been used but six times in fifteen months; I am, therefore, induced to look to some other cause than that of the sluices for maintaining a channel from the coffer dam to the sea.

In the Hartlepool Dock and Railway Company's Works I find the channel is much contracted by their coffer dam, and consequently the influence of the tidal water, when freely admitted into the Slake, is strengthened by this circumstance. I am, therefore, of opinion, that no other agency is necessary under proper management for keeping the channel open.

I have, &c.,
MICHAEL UTWELL SLATER, *Commander.*

To Captain Beaufort, R.N., F.R.S.,
&c. &c. &c.

No 309.

Particulars of Wrecks near the proposed West Harbour.

No. 309.

Particulars relative to Six of the Seven Vessels which (with the "Hope" of Scarborough) were wrecked near the site of the intended Hartlepool West Harbour, on 26th February 1844.

"Carlisle," of Newcastle, a Brig of 222 *tons; Captain, William Gunn; Owner, Mr. Wawn.*

LEFT London on Friday morning, the 23rd of February, 1844, at daylight, bound for Seaham for coals. Reached Yarmouth Roads the same night about 8 o'clock P. M. Brought up there, the wind blowing very strong from S.S.W. with snow showers. Lay at Yarmouth Roads till Sunday at daylight, during which wind blew heavy from N.N.E. with snow showers. At daylight wind veered round to S.W. and then made sail and reached the Humber, when wind shifted to E.N.E. on Monday at noon, and blew a gale with thick snow showers. At 4 P. M. gale so heavy, determined to run for Hartlepool, for the chance of getting into the harbour to save life and ship, as ship could not clear Huntcliffe Foot on the south and Souter Point on the north—both headlands. When attempting Hartlepool Harbour, could not reach in, the channel running too much northward, and consequently ship went on shore about 7 P. M. on Monday, near the intended harbour, which, if formed, could have been taken without the slightest difficulty.

"Brack," of Shields, 217 *tons, Brig; Captain, Alexander Main; Owner, Mr. Wawn.*

Had precisely the same passage as the Carlisle—having left London at the same time, and run on shore about the same place and time,—and was bound to Shields for coal.

"Eliza," of Newcastle, Brig 204 *tons; Owner, Mr. James Fleming, of North Shields.*

Bound for Shields for coal. Left London by same tide with the "Carlisle" and "Brack," and had

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Particulars of Wrecks near the proposed West Harbour.

the same passage. Was driven on shore about ¼ past 6 on Monday evening, the 26th of February, 1844, having tried Hartlepool Harbour and failed in fetching in.

"Lima," of Sunderland, 240 *tons.*

Bound for Sunderland for coal. Had a similar passage as the "Carlisle," "Brack," and "Eliza," but having left London earlier on the Friday morning, had got as far north as Seaham, when the gale came on so severe on the following Monday about noon. Was unable to take Seaham and Sunderland; and, therefore, ran back for Hartlepool, which attempted, but could not reach in, and was driven on shore about 9 P. M.

"Choice," of Newcastle; Owner, William Smith, of Newcastle, 212 *tons, Brig; Captain, David Torriff.*

Had sailed from London on 14th February for Newcastle for coal—had bad weather all the way down. Had proceeded to off Seaham on Monday the 19th, when wind came on to blow heavy from N.E. Could not clear Souter Point; and, therefore, ran back and took the Tees, where ship remained till Monday the 26th. Went out of the Tees that morning between 8 and 9 A. M., wind blowing S.E. Had proceeded a-breast of Seaham again, when gale came on from E.N.E. about 11 A. M. Was obliged to run back and attempt Hartlepool. On coming round Hartlepool Point, John Hunter, a Hartlepool pilot, came on board just outside of the pier, and within the buoys of the channel. Ship grounded—tide more than half-ebb—but flag (denoting that vessels might enter) was up on the pier head. Ship had touched the ground twice before pilot came on board; after pilot came on board, he recommended captain to run for the Tees; and when the vessel got off the bank upon which she struck, the foretop-sail and maintopsail gave way, and was blown on shore. that was about one o'clock P. M. Vessel was light in ballast and drew 9 feet. Her larboard side bilged in. It was low water about 3·30 P. M. Would never have attempted present Hartlepool channel with a N.N.E. course, if new harbour had been in existence with a N.W. and by N. course.

"Rosehaugh," of Cromarty; Captain, Daniel Davidson, (part owner,) 80 *tons register.*

Left London for Newcastle on Friday, 23rd February. Had got about 8 miles north of Hartlepool, when gale came on so heavy from E.N.E. that he ran for Hartlepool Harbour, which he attempted, but could not reach in, and was thence driven on shore about ½ past 6 P. M. Had a similar passage down as the "Carlisle," "Brack," "Eliza," and "Lima."

No. 310.

Report of J. M. RENDEL, Esq., C.E., *on the Hartlepool West Harbour and Dock.*

No. 310.
Rendel, on the proposed West Harbour and Dock.

SIR, 1844.

I duly received your letter of the 8th ultimo, enclosing sundry letters from Messrs. Bell, Steward, and Lloyd, with other papers and plans descriptive of the proposed harbour and dock at Hartlepool: as commanded therein by the Lords Commissioners of the Admiralty, I immediately put myself in communication with the Commissioners of her Majesty's Woods and Forests, and with the several parties promoting and opposing the projected harbour and dock. On the 20th ultimo and following days, I was engaged at Hartlepool inspecting the site of the proposed works, the present harbour and dock, with the shore of the bay generally, and hearing the statement of the several parties. On my inspection, I was attended by their engineers and was aided in the inquiry by the elaborate (Admiralty) chart of the bay made by the late Captain Slater, R.N., in 1838. Since my return the parties have each, as I requested, forwarded to me their case; and I now beg to report on the points their Lordships have submitted to me, viz., how far the objects of the promoters of the proposed harbour and dock may be conceded without injustice to the Companies already established at Hartlepool, and without injury to the navigation of the bay?

The existing interests at Hartlepool are the Pier and Port Commissioners, the Hartlepool Dock and Railway Company, and the Stockton and Hartlepool Railway Company.

The Pier and Port Commissioners are trustees for the public harbour, which in 1813, when the trust was constituted by Parliament, had fallen into great decay. To promote the commerce of the port, and to apply the funds which Parliament empowered them to derive therefrom to the extension and improvement of the harbour, are their sole duties.

The Hartlepool Dock and Railway Company is a Joint Stock Company, incorporated by Parliament in 1832; under the powers conferred upon them, they have formed a commodious dock of 20 acres, and also a tide harbour of 20 acres within the public harbour; and as a means of keeping their tide harbour open, as also the channel from it to sea through the public harbour, they likewise have the power of penning up the tide in what was originally a part of the public harbour called the "Slake," so as to run it off as a scour during low water. Their railway was originally limited to the accommodation of an unexplored coal-field lying to the north-west of Hartlepool; but the success which attended their speculation has carried its extension to long-established and more distinct collieries.

The Stockton and Hartlepool Railway was projected in 1836; the Company was formed in 1839, and the line was opened in 1841. Its object is to connect the several railways communicating with the River Tees with the port of Hartlepool so as to give the numerous and important collieries in the Auckland district the option of shipping their coal in the port of Hartlepool as being more accessible than the Tees. It was a part of the original plan of this Company to form a dock at Hartlepool, and it appears that they have never ceased their efforts to effect their original intention. They, however, on the opening of the railway, entered into a temporary arrangement with the Hartlepool Dock Company for the shipment of the coal sent down their line, and which it was considered would amount to upwards of 400,000 tons a-year. But the result has been, that during the three years which the railway has been opened, the quantity has not averaged one-tenth of the original calculation, or 400,000 tons a-year, and the railway has in consequence proved an unprofitable speculation.

This unfavourable result is attributed by the Stockton and Hartlepool Company to impediments to their trade imposed by the Hartlepool Dock Company, with the view of driving it to their own line of railway, now extending into the Auckland district, as they say in the spirit of rivalry. On the other hand, the Hartlepool Dock and Railway Company state that the price charged by them for the shipment of the coal brought down the Stockton and Hartlepool is, as the work can be done for that, they make no distinction in favour of the traders on their own railway, and that the disappointment experienced by the Stockton and Hartlepool Railway Company is solely attributed to errors in their original calculations as to the trade which their line would command.

The dock now proposed is intended as a terminus for the Stockton and Hartlepool Railway, and its promoters are chiefly interested therein. By its means they expect to realize the trade originally calculated for their railway, and thereby save it from ruin.

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Rendel, on the proposed West Harbour and Dock.

I have before stated that, since 1836, various plans for this dock have been proposed. In 1838, one of the number was approved by the then Board of Admiralty. That plan is appended to this Report, and marked A. The plan now proposed is also appended, and marked B.

The design comprises a dock of about seven acres' area, formed in the marshes immediately within the sea-bank, a basin protected by piers of about 11 acres' area, excavated in the shore between high and low water mark, with a channel leading thereto, from one fathom low water of spring tides. The entrance to the basin is nearly half a mile west of the entrance to Hartlepool Harbour, and its piers are so far recessed as to be within the range of the tidal currents of the bay and the track of vessels to or from the harbour. The entrance channel is to be excavated in a S.S.E. direction, and to terminate about 550 yards S.W. of Hartlepool Bay. The fair-way channel into Hartlepool (from the bar) is N.N.E., which, in gales from north to north-east, makes it difficult of entrance; and it is reported to be of frequent occurrence that vessels are stranded in the attempt.

The chart attached hereto marked C, with the copy of a petition to the House of Commons in the Appendix under the letter F, has been sent to me by the promoters of the new harbour, to show the position of eight vessels stranded on the 27th ultimo, under circumstances of the kind referred to. It is manifest that had there been a commodious harbour in the position proposed, most, if not all of those vessels, might have run for it, after failing in their attempts to enter the present harbour.

I refrain from going into the conflicting evidence of the several parties, as I have appended their own statements to this Report; and I shall now conclude by giving, as briefly as possible, the result of this lengthened investigation on my own mind.

I am decidedly of opinion that the works proposed cannot in any manner prove injurious to the port of Hartlepool, or to the navigation of the bay. I recommend, however, that it should be a condition that the Company maintain their channel by dredging, and that the mode of constructing the piers should be submitted to the Lords Commissioners of the Admiralty for their approval before the works are permitted to be commenced.

After the most anxious and careful attention to the commercial part of the question which alone can decide as to "injustice to the companies already established," I have been unable, from the peculiarly conflicting nature of the evidence, to come to any satisfactory decision, and I am obliged to conclude that it should be left to the searching investigation of a Parliamentary Committee.

Supposing such decision to be favourable to the views of the promoters of the Bill, I am of opinion that the public interest demands that the Lords Commissioners of the Admiralty should stipulate that the tolls now paid to the Port and Pier Commissioners should be leviable by them on all vessels resorting to the new harbour, considering it of the greatest importance that the means at the disposal of this trust should be adequate not only to the liquidation of their present debt but to the enlargement and improvement of the port, a benefit in which, if the plans are sufficiently comprehensive, the new harbour no less than the old would participate.

In the Appendix will be found the following papers:—The Statements of the Pier and Port Commissioners, with the amount of Income and Expenditure, marked D; Particulars furnished by the Hartlepool Dock and Railway Company of their Case marked E; and The Statement made by the Stockton and Hartlepool Railway Company, and the Promoters of the proposed Dock, in support of the Measure, marked F.

I have, &c.,
J. M. RENDEL.

To the Secretary of the Admiralty.

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Murray, on the proposed West Harbour and Dock.

No. 311.

Report of JOHN MURRAY, Esq., C.E., *on the proposed West Harbour and Dock at Hartlepool.*

Sunderland, 2nd March, 1844.

THE harbour of Hartlepool, situated at the northern extremity of the Tees Bay, is peculiarly sheltered by a peninsular headland or heugh. It has a strong natural tendency to silt up: the flood making from the north brings with it much sand, and the debris from the rocks lying to the eastward and northward of the headland: this is naturally deposited near the harbour's mouth, tailing off towards the west, and if artificial means be not adopted, would soon block up the entrance and silt up the harbour.

The jurisdiction of this ancient harbour is vested in the Port and Pier Commissioners, appointed by Act of Parliament, limited on the north by the coffer-dam, which is the boundary between that trust and the Dock and Railway Company's property. This latter body have, however, the power to charge dues on ships entering the Commissioners' Harbour, northward of a line drawn from the west end of the pier to the south-east corner of the Middleton House estate.

The Hartlepool Dock and Railway Company opened their tidal harbour in 1835, the Port and Pier Commissioners having previously and afterwards employed a powerful dredging-machine to open a channel in a direct line seaward with the inner cut, through the accumulated debris and sand above mentioned. A series of sluices, situated at the northern extremity of the tidal harbour, were at the same time brought into operation, communicating with a reservoir of about 120 acres of tidal water called the Slake. This large body of water, being kept in during spring tides till the latter part of the ebb was allowed to run through the tidal harbour and seaward channel, to scour and keep it open.

It was soon found, however, that if by sluicing and dredging a straighter channel were obtained through the sand-bank at the harbour's mouth, yet it would soon become silted up unless the sluicing were continued. Even with the means now employed, the fairway into the harbour is a circuitous channel. No doubt, when the Port and Pier Commissioners have further funds, of which there is every prospect, a pier and other works will be constructed for keeping the channel in one direction, so as to allow the sluicing power to act more directly upon the bar. But their funds are at present inadequate to such a purpose, although they are quite aware of its necessity; but a considerable debt has been already incurred in repairing the outer pier and executing other works which, for want of money, had gradually

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got into decay. If any interference take place with their plans of improvement, so as to increase the deposits in the outer harbour, or upon the bar, it will be impossible for the funds of this trust to be employed in that effectual manner so as to develop the capabilities of this important harbour.

The late Capt. Slater, R.N., reported in May, 1840, that the sluicing apertures then in use, communicating with the slake, when under an average pressure of 10 feet, are capable of discharging 9,000 tons of water per minute; assuming 3 feet at spring tides over an area of the slake of 118 acres, would give 428,340 tons, available for sluicing purposes, which were calculated to be discharged in 47 minutes. He goes on to state in his Report, that even when there were "two feet water at the gauge above the zero of good spring tides, the water was discharged through the cut into the bay at the rate of 7 knots (a little more than 8 miles) an hour, and after leaving the cut, the surface current was observed to make a slight curve to the westward, and at a distance of 2,000 feet from the pier; it then took a more westerly course, having encountered the flood stream."

Captain Slater took very accurate soundings, both in the cut or channel between the coffer-dam and the outer pier, and in the deep water of the bay, to ascertain the effect of the sluices A more favourable opportunity could not have been given, "as in consequence of certain alterations being made in the works adjacent to the sluices, the tidal water had at times been kept altogether out of the slake."

The following is an abstract from his Report :—

In the Cut.

	Feet.		Feet.
The mean depth, in November, 1838 . .	4·69	silted up	1·49
Before sluicing, in May, 1840	3·20		
After sluicing, in May, 1840	3·99	deepened	0·79
After repeated sluicing, in June, 1840 . .	4·16	deepened	0·96

In the Bay, over a surface of 38 *acres.*

	Feet.		Feet.
Mean depth in November, 1838	3·37	silted up	0·30
Before sluicing, in May, 1840	3·07		
After sluicing, in May, 1840.	3·14	deepened	0·07
After repeated sluicings, in June, 1840 . .	3·29	deepened	0·22

In the Bay, over a surface of 133 *acres.*

	Feet.		Feet.
The mean depth, in November, 1838. . .	7·97	silted up	0·24
Mean depth, in May, 1840, after sluicing .	7·73		

But if this surface be reduced to 56 acres, through the point where the surface current was observed by Captain Slater to be affected by the flood tide, at a distance of 2,000 feet from the outer pier, being the entrance of the harbour.

	Feet.		Feet.
The mean depth, in November, 1838 . . .	.6·418	deepened	0·108
After sluicing, in May, 1840	.6·526		

although over the larger area of 133 acres there appears to have been a silting up over the southern surface of the bay. These facts, clearly stated by an unprejudiced and able officer, show that the sluices have had the effect of keeping open the harbour channel and bar at its entrance.

On one occasion I ascertained that, before sluicing, the bar was within the outer white buoy, and there were only ten inches of water upon it at low water. After five sluicings, terminating on the 18th of March, 1843, the bar was found to be 30 yards beyond the outer white buoy, having 2 feet 4 inches of water upon it, being an increased depth of 18 inches.

On the 4th April, 1843 :—

	Distance in Yards.	Rates of Miles per Hour.
The velocity of the water from the sluices to the round head, south of the dock entrance, . .	480	2·727
Between the round head and the coffer-dam . . .	100	6·818
Between the coffer-dam and the jetty.	320	3·522
Between the jetty and the pier head	150	10·227
Total distance	1,050	
Average on the whole distance	3·58 miles per hour.	

This variable current shows in the plainest manner the irregularity of the bed, and that if means be employed to remove the obstructions, the scouring power would act with still greater force on the bar.

The efficient time of sluicing is only at or near the top of the spring tides, and 50 minutes is the longest to run off the water from the slake to produce any effect by scouring; but the first 30 minutes is the most effectual; commencing about an hour before low water.

The Hartlepool Dock and Railway Company therefore tenaciously cling to their sluices, having the greatest reliance upon the beneficial effects produced by them; and they submit, that so long as they afford accommodation to the public at a rate lower than adjacent ports, they ought not to be deprived of this scouring power, which is the only means they have of maintaining their harbour.

It is also the duty, and greatly the interest of the Port and Pier Commissioners who receive such benefit to their harbour by these operations, to see that no works be constructed within their jurisdiction which may prove injurious to their harbour. Let us view the effects likely to be produced by the projected works of the west harbour and dock :—

The flood tide makes from the north, and striking the Long Scar Rocks, performs the circuit of the bay. In its course much sand is brought into it which must be deposited in the proposed channel and outer harbour. The piers throw out their arms, as it were, to receive it. If dredging power be employed to keep the harbour, enclosed by them, clear of sand, its operations will be unceasing. As to the channel beyond the entrance piers, nothing can prevent it from silting up but incessant sluicing. The small area of the inner dock would be of little or no use for such a purpose. If powers be given

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to the projectors to abstract water from the adjoining slake for sluicing. such permission would have the effect either of injuring the entrance into the present harbour, or the sluicing power now in use would do injury to the proposed channel and harbour; for, taking a line midway between the projected entrance piers, in a direction parallel with its south pier, viz., S.S.E., the bar of the present channel lies 670 yards distant. The sluices of the present works are 1,250 yards from the bar. Capt. Slater observed the surface current to be affected by the flood tide at the distance of 2,000 feet, which is 1,717 yards from the sluices; but this long distance was caused by the scouring water attaining a velocity of 7 knots an hour through a confined cut or channel within the outer pier.

Nothing of this kind can be obtained at the projected works, consequently the velocity of the current will be lost at about 600 yards from the pier heads, which is the position of the present bar. It will, therefore, receive increased deposits and tend to tail the bar to the westward, doing great injury to the entrance and seriously affecting the ultimate improvement of the present harbour.

The piers of the projected outer harbour must act like groynes for collecting the sand brought northward by the flood tide. To get rid of the sand so trapped, it must be sluiced into the bay, and if the direction of the sluicing water be as shown on the plan, in the line of cut, the sand sluiced out, just stirred up and alive, must be brought on the returning flood tide into the channel and present outer harbour. If the deposits be removed by the present sluices, yet this counter sluicing must eventually place the harbour of Hartlepool in the greatest jeopardy.

Let us now see whether the projected dock can save lives and property or give any increased accommodation in this respect to the public. The size of the inner dock is proposed to be about 7 acres, which might afford space for about 70 to 80 coasting vessels. The outer harbour is proposed to have an area of about 10 acres, with an entrance between piers of about 276 feet in width. The Stranton shore where this harbour is proposed to be placed is exposed to gales from the N.E. round to the S.E., which beat violently upon it. During the prevalence of such winds the projected harbour would be liable to be silted up, and if this took place to the height of the present beach, of which there is every probability, there would only be 12 feet of water at ordinary spring tides between the pier heads. The vessel entering such a harbour under sail, must encounter a considerable send of sea and take a narrow entrance in broken shallow water where she must be nearly unmanageable. If she does enter, the room to bring up is not a cable's length from the entrance piers to the opposite wall, where she must knock herself to pieces: no vessel dare attempt it in a storm from the eastward. On the other hand, what better shelter can be required than the long run into the present harbour, where every facility is given to save life and property?

It must also be borne in mind that during northerly gales, vessels in attempting to take refuge in the present harbour enter the bay by setting in direct upon the Stranton shore as near as they can, and then, tacking under the lee of the heugh, steer directly into the harbour, by coming close to the eastern end of the jetty. If the projected piers be lengthened into the deeper water of the bay to make the run longer into their outer harbour, it will render the access to the existing harbour more difficult, and materially cripple its powers as a harbour of refuge for coasting vessels.

JOHN MURRAY.

To James M. Rendel, Esq.,
&c. &c. &c.

BRIDLINGTON.

No. 312.

Bennett, on the State of the Harbour.

No. 312.

BRIDLINGTON HARBOUR.

[MR. BENNETT, *Collector of Customs, having left the Room under the Impression that the Inquiry would be continued on the following Day, has submitted the following Statement as his Evidence*:]

I HAVE been collector of Customs at this port nine years, and have witnessed much to disapprove of in the management and regulation of the harbour.

First, there is no proper leading light for ships to enter during the night, nothing but a lantern with a couple of small candles; nor is there any flag-staff except for the tide-flag; nothing to direct strangers attempting the harbour when the weather is so bad that boats cannot get out.

There has been no control over the persons calling themselves pilots: many there are that bring ships in who have not been to sea, that is, they have not served an apprenticeship to the sea service, but are fishermen, charging as they please.

They bring ships into the mouth of the harbour before there is sufficient water to haul up to their moorings.

Several times I have seen these disgraceful proceedings, while one ship is taking the ground, without common precaution or care, others are run in, the one smashing the other to pieces. The harbour-masters have been improper persons. I have had occasion to speak and request that the ships may be directed to haul up the harbour out of the way of others, and have been insulted. I have requested that directions might be given to the men calling themselves pilots (for there are no pilots) not to bring ships into the harbour until there be sufficient water, and not to stop up the entrance, but there has been no control.

The more mischief, the more work for carpenters and sailmakers, and survey for damage.

The harbour has not been kept clean of mud; it has not been deepened in a proper manner.

There is no proper accommodation for ships to discharge; the legal quay is only sufficient for one ship in length, consequently they lie four or five outside each other, with danger to themselves and to the obstruction of the passage of ships entering for refuge. Many of the vessels have to lie on their broadsides and discharge their cargoes into carts. The present harbour is excessively small and scarcely merits the name of a place of refuge; but still, had it been kept clean and deepened, many more ships might have taken it for shelter.

It has nevertheless been receiving a passing toll for 150 years; and no equivalent, no accommodation for ships to discharge up the harbour has been provided out of it. It has been called a harbour of refuge, and an income has been secured by the Act, 1 Vict. c. 110, for 31 years longer, with the ancient toll of Elizabeth, and with duties upon almost every article you can mention brought in, or shipped from, with 6*d*. per ton upon ships, &c., for ever.

It was in the Petition of Prayer, in support of the Petition for the Act of 1 Vict., expressly set forth as a Harbour of Refuge for the Saving of Lives, and an enlargement thereof; but there is only one opinion upon the subject, that as a harbour of refuge it has been lost sight of; or before the enlargement is half

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completed, the upper and most valuable part (as a harbour of refuge) has been cut off by the building of a stone wall 8 feet thick right across it, and about 70 yards from the cliff; this upper part of the harbour would have afforded a fine place for vessels running in for shelter to take the ground without letting go an anchor (a very desirable object in a small place), and from whence they might with a rope be easily and speedily hauled out of the way of others, running in quick succession. There are also buttresses or abutments built on the inside of the new south pier, which will endanger and obstruct ships running in and up the harbour with a wind from north-west or north-east; and when a number of vessels are moored in the harbour with the wind in the same direction. On these abutments the ships will carry away their bowsprits, &c., independent of the eddy they cause in the harbour.

This cross wall is about 70 yards from where the sea should expend itself, and when the new part of the harbour is deepened according to contract, this stone wall will stop the roll of the sea, (and there must be at all times more or less) which will meet this obstruction, and rebound into the harbour instead of expending itself upon the shore.

The entrance into the harbour is difficult, and there is every reason to believe that ships will miss the entrance, and if so, will meet outside the new south pier, with a stone causeway of rough Whitby stone, raised five feet above the ground.

If the unfortunate ship escape this with the loss of her keel only, there is a sea wall in the angle and stone road to complete the wreck. These works have been carried on, it is said, to protect and support the new south pier: the sea wall and stone road for some purpose best known to those who have the management of the funds.

JAMES BENNETT, *Collector*,

No. 313.

Complaints of the want of Accommodation in Bridlington Harbour.

No. 313.
On the want of Accommodation in the Harbour.

SIR, *Bridlington Quay, 8th December*, 1845.

I beg to make a statement of the internal management of this harbour for the information of the Tidal Harbours Commission.

I addressed the following note to the Pier Commissioners on the 2nd instant:—"Gentlemen I beg to represent to you the want of safe and convenient places to load and deliver ships; the old crane and jetty are generally crowded, and often there is so much sea on as to render them unsafe. The slipway is in a bad state; during neaps it can only be used early in the morning and late at night; the wharf at Clough Hole can scarcely be come at even during spring-tides, and there is a want of proper mooring-posts.

"I am, &c.,
"*To the Pier Commissioners.*" "JOHN FROST."

To this no reply was made.

On the 4th instant I had a small vessel laden with coals and hones from Newcastle, which came up to the Clough Hole Wharf: previous to commencing discharging, the harbour-master brought orders from the Commissioners that he was not to deliver there; I sent to inquire if he had written orders, or was the orders or minutes entered in a book: to the first query he replied, "he had not;" to the second, "he did not know."

To disobey his orders is a penalty of 20*l*. No ship or lighter was at the wharf at the time, or is yet. Four ships were discharging coals at the old crane; there was not room for a ship to enter the harbour and pass between the outside ship and the north side of the Dolphin.

At the slip the tide was in during the whole or most of the day. The road is so bad that cartmen charge three pence a-ton extra for loading.

I had another small vessel laden wholly with coals, but she lay in the middle of the harbour until she could get a berth at the crane, or the tides allowed delivery at the slip.

I am, &c.,
JOHN FROST.

No. 314.

LYNN.

Letter from Lord G. BENTINCK *to* JOSEPH HUME, Esq., *on the state and the means of Improvement of Lynn Harbour.*

LYNN.

No. 314.
Letter from Lord George Bentinck, on the State of the Harbour.

DEAR SIR, *Welbeck, near Worksop, Notts, 2nd Dec.*, 1845.

Having learnt that in your capacity of a Tidal Harbours Commissioner you have lately been visiting some of the harbours on the eastern coast of England, when, whilst you inspected the harbours of Wells and Great Yarmouth, you passed unnoticed the harbour of Lynn, I take the liberty of calling your attention to the great capabilities of that port, feeling assured that no apology for thus troubling you will be required, knowing, as I well know, that trouble and labour, when spent in the public service, is a pleasure to you.

In Lynn Harbour the rise and fall of the tides, under existing circumstances, amounts to 11 feet in the neap and to 17 feet in the ordinary spring tides, whilst at low water at spring-tides, the depth of the channel in the harbour of Lynn varies from 10 to 12 feet, making a total depth at high water in Lynn Harbour of not less than 27 feet in ordinary spring tides, nor less than 21 feet in neap tides.

But you are no doubt aware that under the auspices of a company, whose object it is to inclose a great portion of the estuary of the Wash, with a view to obtaining land thereby, it is intended by straightening the channel and confining the tidal waters, so to improve and deepen the outfall of the Ouze, by scouring it out, that an additional four feet at the least will be scooped out by the effect of this scour from the present bottom of Lynn Harbour, thus making the least depth at high water of ordinary spring tides 31 feet instead of 27 feet, and the least depth at low water of spring-tides 12 feet instead of 10 feet, as now, the calculation being, that whilst the new and invigorated scour will lower the bottom of the channel four feet, two feet only will be gained in depth of water at low water, from the circumstance that it is expected (indeed, by the experience of the new outfall improvement, it may be said to be ascertained), that the tide will ebb two feet lower, that is to say, that the surface of the water at low water will be two feet lower than at present, thus, though the entire benefit of the four feet scour will be felt at high water, half that benefit only, viz., two feet, will be enjoyed at the extreme ebb of the tide.

I need not state to you, who are so well informed upon all commercial subjects, that 12 feet of water would be sufficient to float a considerable portion of the colliers and coasters which chiefly trade

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on the eastern shores, whilst 31 feet equals, if it does not exceed, the draught of water required to swim the largest three-decker in the Royal navy.

It is right, however, that I should here state, that whilst the depth of water is that which I have above written in the harbour, a discrepancy of two feet will always exist between the depth of water in the harbour and that of the channel to the advantage of the harbour, occasioned by the scour of the tide under the bottom of the ships moored and riding in the harbour, making, as it were, a great deep hole of that part of the channel which constitutes the harbour, whilst at present a much greater discrepancy exists out of the constant accumulation of shifting sand-banks creating shallows in the channel to sea, over which, at the extreme ebb of spring tides, the depth of water does not exceed two feet, neither does it exceed 19 feet at the top of the flood tide; this inequality and this anomaly, however, with the exception of the two feet which I have already explained, as regards the harbour itself, will cease to exist whenever the projected improvement of the Ouse outfall takes place, when, I believe, I may safely affirm, uncontradicted by any of the great engineers, that the entire channel from the debouchure, the actual harbour of Lynn, will be of one uniform and gradually increasing depth to the sea, no where less than 10 feet at low water, nor less than 29 feet at the top of the flood; but, taking the medium, viz., the half tide, there will be six hours upon every tide, 12 hours in every 24, when there will not be less than 20 feet 6 inches of water or upwards in the shallowest part of the channel below Lynn, nor less than 22 feet 6 inches or upwards in the harbour itself.

To the projected improvement of the Ouse outfall I should here observe, that a notice has been given, though by different parties, of an intention to apply to Parliament for a Bill for the construction of wet docks at Lynn. Crude as seems this project at present, it is to be presumed that in constructing wet docks at Lynn care would be taken that the depth of water in them should not be less than that in the channel of the harbour itself, that is to say, under the projected improvement of the Ouse outfall 25 feet in times of neap, and 31 feet in times of ordinary spring-tides.

I now pass on to Lynn Roads, where it is well known there is good holding anchorage ground, and that ships may anchor in from six to eight fathoms at low water of ordinary spring-tides. The approach, too, is easy, as well by night as by day, having a floating light as a leading mark, with a beautiful cross light on Hunstanton Point to mark out the anchorage. Once anchored in Lynn Roads, there are no gales, except those coming from N. to N.N.E., or within those points of the compass from which any ship would not be perfectly secure.

Lynn Roads, or Lynn Well as it is called, is, by the present tortuous course of the channel, distant 15 miles from the harbour of Lynn; this distance will be reduced to 11 miles upon the completion of the new cut and attendant Ouse outfall improvement.

With a strong flood-tide and a strong leading wind, which every northerly gale must be, ships now run up from the Well to Lynn Harbour in an hour and a half, or from that to an hour and three-quarters; the flood-tide now runs between three and a half and four knots per hour. Upon the completion of the new channel to sea this speed must necessarily be increased by one-fifth in keeping with the increased rise and ebb of the tides. Thus, under the joint operation of reduced distance and increased speed of the tide, it will not be an over sanguine speculation to calculate that an hour and ten minutes, or an hour and a quarter, will suffice, under the projected new order of things, to bring up the heaviest laden merchantman safely into Lynn Harbour from her anchorage in the Roads.

But there is also another anchorage, with water sufficient for vessels of considerable burthen, four miles nearer to Lynn, which, when the new cut is made, will be brought within eight miles of Lynn; from this anchorage ships now run up to Lynn, under favourable circumstances, in an hour and a quarter; upon the completion of the new cut, 45 minutes, or 50 minutes at the outside, will fully suffice for the purpose.

There is one point more with regard to the tides in which I ought to advert: the flood in spring-tides now runs up 3½ hours, and the ebb runs out 8¾ hours; judging from the effect of like works upon her sister river, the Nene, there can be no doubt that, upon the improvement of the Ouze outfall, the tide will flow at least 4¼, if not 4½ hours, which, with the additional depth of water created by the scour, will make the river navigable for full three hours more than at present upon each tide, viz.: two hours more on the flood, and one hour more on the ebb.

It was, however, once contemplated, that the improvement of the navigation of the Great Wash should not be limited to the Ouze, but should comprise the outfalls of the Nene, the Welland, and the Witham, thus bringing these four great rivers into one straight and magnificent channel, whereby, amongst innumerable other benefits, a most noble roadstead would be accomplished, which no gales come from where they might, could disturb.

Want of funds has alone prevented the execution of this splendid work by private enterprise; 1,250,000*l.* was the estimate for its completion, whilst it was calculated that the rich lands comprising 75,000 acres, to be recovered from the sea by these works, would amply repay the cost of them.

The object of my present appeal to you, as one of the most energetic of the Tidal Harbours Commissioners, is to call your mind and attention to the vast capabilities of the Great Wash for a harbour of refuge, where most of all a harbour of refuge is required, perfectly satisfied in my own mind that at a less eventual cost than anywhere else on the east coast the most extensive and magnificent harbour of refuge might be constituted.

For more detailed and more scientific information, I would refer you to Sir John Rennie and Mr. Rendel, who have already given much of their time and attention to this subject, and would be proud of giving you every information in their power.

I have only to add, that the railway communication already within 33 miles of being perfected between Liverpool, Manchester, Birmingham, Gloucester, and Bristol, on the one side, and Lynn on the other, points out Lynn and the estuary of which I have been writing as the natural outport to the Baltic, of all the great commercial and manufacturing towns and cities which I have above named.

I have, &c.,
G. BENTINCK.

To Joseph Hume, Esq., M.P.

P.S.—Should you be prevailed with by this letter to visit Lynn, I will undertake to ensure you not only every attention and courtesy from the Mayor (Mr. Francis Cresswell), but if you will only give him notice of your coming, he will have in readiness all the most intelligent nautical men connected with Lynn ready for your examination. Should you wish also to visit the Nene Outfall, and see with your own eyes the practical results of the works upon that river, the means of doing so shall likewise be prepared for you.
G. B.

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NORWICH.

No. 315.

Soundings of the Yare within the Jurisdiction, and dimensions of the Bridges, of the City.

No. 315.

NORWICH.

STATEMENT of the Depths of the River Yare in the whole distance of 19¾ miles, under the jurisdiction of the Corporation of the City of Norwich, also of the dimensions of the Eight Bridges across the river at the City.

SOUNDINGS.	Miles.
From Carow Bridge to Whitlingham Dyke, 9 feet to 9 feet 6 inches	2
From Whitlingham Dyke to Postwick Hall, 10½ feet to 11 feet, with one exception, opposite Thorpe Church, 9 feet 6 inches only	2
From Postwick Hall to Surlingham Ferry, 10 feet to 12 feet	3
From Surlingham Ferry to Coldham Hall, 10 feet to 12 feet, until near Coldham Hall, where there are mud banks, reducing the depth to 9 feet 3 inches	3
Coldham Hall to Buckenham Ferry. from the Hall to Strumpshaw Dyke, ¾ mile, 12 feet 6 inches, thence to Buckenham Ferry, 12 feet to 16 feet	4
From Buckenham Ferry to Langley Staithe, small part only opposite the Staithe, 12 feet 9 inches, remainder varying from 14 feet 6 inches to 16 feet 6 inches	2
From Langley Staithe to the Devil's House, 12 feet 9 inches to 14 feet. . . .	1¾
From Devil's House to Hardley Cross, in a short first part of the distance, 11 feet 9 inches, and 14 or 15 feet in the remaining greater part	2
	19¾

SAM. S. BEARE, *Commissioner for Norwich.*

DIMENSIONS of the Eight Bridges over the River at Norwich City.

Norwich.	Width across from Bank to Bank.		The Extent of Water Way.		Number of Arches.	Width of Arches.		Width of Piers and Abutments.	
	Feet.	Inches.	Feet.	Inches.		Ft.	In.	Feet.	Inches.
St. Miles Bridge . .	38	8	35	8	One	35	8	3	0
Duke's Palace . . .	67	2	62	6	One	62	6	4	8
Black Friars . . .	52	0	42	3	One	42	3	9	9
Fye	39	1	33	9	One	33	9	5	4
White Friars . . .	37	5	29	6	One	29	6	7	11
Bishop ditto . . .	76	9	56	2	Three	19 21 15	4 6 4 } Ft. In. 56 2	20	7
Foundry	62	6	55	0	One	55	0	7	6
Carow	59	3	47	6	Three	30 8 8	0 9 9 } Ft. In. 47 6	11	9

Nov. 5, 1845.

JOHN BUNN, Jun., *City Surveyor.*

COLCHESTER. *River Colne.*

No. 316.

Vetch and Washington on the Improvement of the Colne Navigation.

No. 316.

COLCHESTER.—RIVER COLNE.

Captain VETCH, R.E., *and Captain* WASHINGTON, R.N., *on the Improvement of the Colne Navigation.*

SIR,

15, *Duke Street, Westminster*, 22nd *April*, 1846.

In compliance with your letter of the 15th instant, directing us to examine into the circumstances and condition of the navigation of the river Colne, and to investigate the report for the information of the Lords Commissioners of the Admiralty, on the effects likely to arise from carrying certain measures into execution which are set forth in a bill now before Parliament, we have the honour to report:

That we proceeded to Colchester on the 17th instant, and commenced our inspection of the channel of the Colne, at the village of Wivenhoe, at the time of low water, attended by individuals of both parties interested in the question, and by pilots and seafaring men conversant with the navigation of the river. From Wivenhoe we went down the river, and observed the position of the Hound and Ooze End Points; proceeding thence up the bank of the river, we inspected the channel from Wivenhoe by Rowhedge to the lock and bridge at the Hythe. and thence up to East Mill at the head of the tide-water, and in our course, had the sites of the proposed measures pointed out to us by the assistant engineer. Having finished our inspection on the ground, we adjourned to the town-hall, to take the evidence of masters and pilots acquainted with the navigation, and to hear what the parties interested might have to urge on our attention, and also to receive any explanation the engineers who planned the works had to offer.

Since the 17th instant, we have perused all the reports and documents furnished to us, and have referred to such maps and charts (including the Admiralty Chart of the East Swin, by Captain Bullock, R.N.) as serve to throw light upon the subject. Previous to entering on the expediency of the measures proposed to be executed with the view of improving the navigation of the Colne, it may be useful briefly to state the extent and condition of the river and estuary as now existing.

The Colne and Blackwater have one common outlet into the Wallet—a secure and capacious roadstead, sheltered from the south-easterly gales by the Gunfleet sand. The approach to the Colne from this roadstead is over a flat, three cables' length in width, having a depth of 15 feet at low water,

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and 30 feet at high water springs; from this spot, or the Knowl buoy, to the entrance of the river at Brightlingsea Creek, is five nautic miles, the depth varying irregularly from 22 to 40 feet.

The width of entrance here from shore to shore—that is, from Mersea Stone on the west to St. Osyth Stone on the east, is half a mile; and the low-water channel (of 12 feet depth) is one-eighth of a mile wide; this latter width and depth continue upwards about a mile further, forming the usual anchorage off the village of Brightlingsea. Proceeding upwards, the channel gradually contracts and shoals till we reach Hound Point and Ooze End, just beyond the entrance of Alresford Creek, above which, at above half a mile below Wivenhoe, the channel (with the exception of the small stream of the Colne) is dry at low water.

Thus it will be seen that, strictly speaking, there is no bar at the entrance of the Colne to vessels drawing 14 feet—the usual draft of those trading to the port.

The rise of tide up to Wivenhoe is stated at 16 feet on springs, gradually decreasing to 9½ feet at the Hythe; on neaps it is 4½ feet less.

As before mentioned, the width of the Colne at its entrance is half a mile, or 1,000 yards; at Wivenhoe, 4 miles up, it is 120 yards at high water; at 5 miles it is 80 yards; and at 6 miles 40 yards; at 1-6th of a mile above occurs the old lock, where the river is artificially throttled to a width of only 8 yards; from this spot it again widens to 20 yards, and preserves this width up to the Hythe Bridge, the head of the navigation for vessels with fixed masts, but barges and lighters may ascend three-quarters of a mile beyond, as far as East Mill: thus making a total distance of 7½ nautic miles of tidal navigation from the mouth of the river to East Mill. In ancient times, it is probable that the tide ascended much higher; but the water of the river has been diverted from its natural course, and applied to other purposes than that of scouring its original bed.

The depth and breadth of the river have been restricted by impediments both natural and artificial, but chiefly the latter. Above Brightlingsea, a large space in the fair channel of the river is devoted to oyster-beds; and it is hardly possible to conceive any thing more prejudicial to the tidal scour; the next obstacle to the navigation is caused by the Hound and Ooze End Points, about one and a half miles below Wivenhoe, but these might easily be removed by dredging; the third impediment is that of the lock opening into the Hythe or Haven of Colchester; this lock is of considerable age—probably more than a century, and it is in the last stage of decay, the lower gates having long since disappeared, and the sides and bottom of the lock are very ruinous, and the upper gates are full of leaks; these gates are kept open or shut, to serve any occasional object that may arise, and as far as we could learn, they remain more frequently open than shut; when shut, they serve to produce still water, and to cause a deposit of the mud brought in by the tide; and in the summer season, the current of the land-streams is not sufficient to remove the silt thus deposited.

Whatever benefit the lock may have conferred a century ago, cannot now be surmised; the present effect of it is to cause a sudden shoaling of the depth of the river to the amount of 1½ foot, and a contraction of the width from 40 to 8 yards, thus impeding, most prejudicially, the flux and reflux of the tide for the distance of more than a mile.

Above the lock just described, the width of the river is only 20 yards; this sudden contraction from 40 yards is, no doubt, partly owing to the want of the natural scour, and partly to the encroachments of frontagers, in projecting their quays and warehouses too much into the bed of the river; so that when a barge is lying along on each side, there is no room for a third to pass.

We have now to take into consideration the measures proposed in the Bill before Parliament, for improving the navigation of the Colne; the essential features of it are—

1. The construction of a dam across the river about 1½ miles above Wivenhoe, and thereby converting the upper tidal course of the Colne into a still-water canal or floating dock, penning up the water from East Mill downwards for a distance of two miles, and of maintaining its surface constantly to the level of high water of ordinary spring tides, thereby depriving East Mill of three feet of its usual fall.

The most obvious effect of this measure is, that of interfering with and injuring, over a great extent, the drainage of the adjoining land, and the sewerage of a portion of the town of Colchester, and of keeping the low ground saturated with moisture. It is true that the Commission under the Bill takes powers to provide all necessary drains, but the system of drainage is not distinctly pointed out; and there appears to be great difficulty in successfully attaining the object, except at a very heavy expense, which does not appear to be provided for; and the difficulty is farther increased by the porous nature of the strata through which the proposed canal extends.

The engineer to the present scheme, in a report dated 1840, deprecates the plan of converting the present river channel into a floating basin: he states "such a plan is not advisable, when the drainage of the country is considered; how strong and heavy the floods are occasionally, and the effect of penning up so great a portion of the river channel to high-water level. The waste water of the mills, streams, and drains emptying themselves below high-water mark, would be a serious impediment to such a plan."

In the above opinion we entirely agree; and further, that if the difficulty and expense of providing the above drainage were accomplished, it would interfere with the improvements of the land and the sanitary condition of the town, in respect to both of which, the lowest outlets have to be carefully preserved.

2. We have next to consider the effect of penning up two miles of the upper part of a tidal river on the navigation of the lower part. By such a measure, the tide is not only prevented supplying and receiving back, twice a day, a volume of water equal in capacity to the extent of channel cut off, but the momentum acquired in passing over the distance, is also lost to the lower portion of the river. In the present case, the scour of about three million cubic feet of water will be lost to the channel each tide, and the length of the tidal flow will be shortened by two miles out of seven, and the momentum of the tide proportionally lessened.

The funnel-shaped estuary, so useful for producing high and rapid strides, here exists; and if the impediments noticed were removed, the scour of the tides might produce the most valuable results. On the river Orwell, in a distance of twelve miles, the improvements there effected have produced an increased range of two feet of tide at Ipswich quays; and in the Colne river, if the present obstructions were removed, an effect of the same kind, to some extent, might fairly be expected, by which the channel would be deepened, and the natural drainage preserved; whereas, by the adoption of the measures proposed, the future improvements of the channel will not only be prevented, but we apprehend great injury will be caused to the lower part of the navigation.

In addition to the objections already stated to damming up the river, the silt brought down by the winter floods must deposit in the still water of the floating dock. The nature of the strata, consisting

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of the clay and sands of the London basin, is very pervious to water; and with a pressure of 16 feet at time of low water, it is to be feared that numerous springs and boiling places will then arise in the bed of the river, tending to undermine the banks and disturb the bottom of the channel—effects which exist at present in some places, from causes apparently of less energy.

The second measure as proposed in the bill, and now to be noticed, is the formation of a ship canal from Rowhedge to the channel of the river above the proposed dam, the entrance to the canal at Rowhedge being provided with lock and gates; so that for vessels bound to Colchester, the tidal navigation will there end.

From the proposed lock at Rowhedge to the dam the bed of the river will become disused, and the flow of tide being arrested at the dam, the current will thereby be much weakened in that part of the channel, and a great deposit of silt must then be expected over the length of about a mile; so that in progress of time this portion of the river channel will also be lost to the action of the tides; and besides the mere volume of tidal water thus abstracted, the length of the column of tidal water will be further reduced to 4-7ths of its original length, and the momentum proportionably decreased; and it appears to us very difficult to conceive that such large abstractions from the volume and activity of the tide can be made without producing most injurious effects on the navigation of the lower part of the Colne. The only drawback at present to the scouring qualities of the Colne estuary is the shortness of its course, which does not permit of all the momentum of tide being acquired that might be desired; but by the proposed plans the length of the estuary, already too short, would be eventually reduced to 4-7ths of its original length.

We therefore, after a full consideration of the subject, have formed a decided opinion that the conversion of the bed of the upper portion of the Colne into a floating dock would prove most injurious to the general navigation of the river. Nor do we perceive any benefits which these measures could confer on the merchants of Colchester that could not be attained (at less cost, in an equally short time, and with greater security) by improving the present channel of the river, by proceeding in a manner somewhat similar to what has proved so successful in the Clyde, the Liffey, and other important tidal rivers.

At the same time that we express our opinion against the plan proposed for the improvement of the Colne navigation, we are strongly impressed with the value of that estuary, and of the importance of improving its navigation by every safe and feasible means.

We are of opinion that by some obvious measures of easy execution much benefit would arise, and these would chiefly consist in removing the obstructions or impediments already alluded to.

1st. The removal of the old lock, by which means 18 inches more water would at once be obtained in the Hythe; by that means and from the constant additional flow and scour of the tides, in all probability 6 inches more depth would be derived in a few months, the and Hythe be thus deepened 2 feet.

Most of the mariners who gave evidence were of opinion that of late years the navigation had improved; and we are inclined to attribute the chief part of that benefit to the removal of the old Roman bridge at the Hythe, in 1837.

The next step in improvement would be to apply a steam dredge to cut off the Hound and Ooze End Points. As compared with other rivers, the Colne preserves an unusually straight course, its curves being generally easy; but where salient points occur they should be rounded off, and afterwards the dredge should be used to reduce the bed of the river to one uniform descent.

It appears, from the papers laid before us, that since the year 1811 up to the present time, a sum of not less than 50,000*l.* has been received as channel dues. Had the annual income of 1600*l.* been steadily and systematically laid out in dredging and improving the channel of the river, all the measures we have suggested might have been carried out, and Colchester, like Ipswich, now have had a depth of 14 feet water at its quays.

We are, &c. &c.,
(Signed) JAMES VETCH, Captain R.E.
JOHN WASHINGTON, Captain R.N.

To the Secretary of the Admiralty.

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No. 317.
Vetch and Washington's Second Report on the Improvement of the Navigation.

Second Report of Capt. VETCH, R.E., *and* Capt. WASHINGTON, R.N., *on the Improvement of the Navigation of the Colne.*

SIR,

15, *Duke Street, Westminster*, 25*th June*, 1846.

IN compliance with their Lordships' directions contained in your letter of the 25th May, we have had under consideration the letters addressed to the Lords of the Admiralty by the solicitors for the Bill now before Parliament, dated the 22nd of May, and accompanied by plans, submitting several modes of executing the works proposed in the Bill, intending to obviate the objections which we found necessary to urge against the original plan, as pointed out in our Report of the 22nd April last; we have also had under consideration certain memorials against the Bill. The plans and propositions above referred to not appearing to us free from former objections or sufficiently explicit, we considered it would be desirable to procure a conference with the solicitors to the Bill and their engineer, and endeavour to come to a mutual understanding as to the character of the works to be executed, which, while they should answer the views of the promoters of the Bill, would be such as we might recommend for the sanction of the Lords Commissioners of the Admiralty. In consequence of this opinion, we had repeated conferences and discussions with the parties promoting the Bill, and the result has been that they have consented to remodel it, so as to adopt the views and recommendations pointed out in our first Report. The alterations are as follows:—

1st. Instead of taking power to raise 50,000*l.* (or thirty times the present annual income from channel dues), 30,000*l.* only will be raised.

2ndly. Instead of damming up the river, and making a new cut, constructing a lock and floating basin, the funds so raised to be applied chiefly to deepen, widen, and improve the natural channel of the river, and also to remove the projecting points and fords.

The amended Bill leaves the natural outlets of the drainage untouched, so that all the objections we took to the original plan have been yielded to, or provided for, and in addition to the usual Admiralty clause, the two following clauses have been introduced into the Bill:—

"1. And be it enacted, That the said Commissioners shall and will, at any time after the passing of this Act, upon being required so to do by the Lord High Admiral, or the Commissioners for executing the office

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of Lord High Admiral for the time being, remove and take away the present lock in the Colne, and from time to time widen, deepen, and improve the said river, between the Hythe Bridge and Ram's Hard, as the said Lord High Admiral, or the Commissioners for executing the office of Lord High Admiral, shall direct."

"2. And be it enacted, That the said Commissioners shall provide a public wharf, or quay, of the extent of one hundred yards, next the said river, between the Hythe Bridge and a place called New Quay, and shall and may charge reasonable dues for the use thereof, to any person or persons desirous of using the same."

With these conditions we submit that their Lordships may give their assent to the Bill.

There are, however, some points in the amended Bill to which we think it necessary to direct their Lordships attention.

In reference to the first of the above clauses we submit, that as soon as the Bill shall have passed, the Lord High Admiral should call upon the Commissioners to remove the old and ruined lock, as the first and most important step towards the improvement of the navigation; and to require that plans and sections for improving the channel of the river be forwarded to the Admiralty for approval. In the Bill now before Parliament the same clauses are inserted which form part of the present Act, viz.—Nos. 92 and 93, which apply a portion of the revenue from dues on shipping towards paving, lighting, and improving a part of the town of Colchester. To this we strongly object, as a system liable to great abuse, by the misapplication of funds, derived from shipping, to other purposes than those of improving the navigation; and in order that due control should be exercised in restricting the application of funds so derived to their legitimate object, we consider it would be but reasonable that the Admiralty should make the following requirements:—

1st. That the proposition for improving the natural channel of the river should be preceded by a new map or chart of the river, and this we consider will be best effected by continuing the Admiralty chart of the East Swin and entrance of the Colne from the point where it now stops short, up to the Hythe Bridge.

2ndly. The improvement of the channel of the river can only be effectually carried out by the application and systematic use of a steam dredging-machine, reducing the bottom of the river at the Hythe Bridge to a full depth of not less than 15 feet below the high-water mark of ordinary spring tides, and thence by a uniform descent to the deep water at Brightlingsea Reach.

3rd. The widening of the river at Row Hedge to 300 feet at the level of high-water mark.

4th. The widening of the river from Stake Reach to the site of the old lock, by a gradual taper to 120 feet at the latter place at high-water level.

5th. The alteration of the entrance of Roman Creek, so as to cause it to enter the Colne at an acute angle, pointing down the stream (an essential condition in all affluents, in order to preserve the channel clear of deposits at the point of confluence); and for the same reason the mouth of the Alresford Creek, which now joins the Colne at right angles, should have its entrance changed, so as to point down the stream.

It is to be regretted that the jurisdiction of the Channel Commissioners under the present Bill does not extend below Ram's Hard, as Hound Point, Ooze End, and the entrance of Alresford Creek occur a little lower down the river, all of which we deem it important should be under the same control and management.

Under clause 58 of the Bill it is provided, that unless the Corporation of Colchester or the Colne Fishery Company do, within twelve months after the passing of the Act, take away portions of Hound Point, leaving 100 yards as the limit at low-water level, for the passage of vessels, it shall be lawful for the Channel Commissioners under the Act to do so.

No notice, however, is taken of Ooze End, which, as far as we are able to judge, without a chart of the river, is an equal obstruction with the former. It is stated that the removal of this point would damage the Colne Oyster Fishery. We should be the last to recommend any interference with a fishery that is well known to have raised a hardy race of sailors, but if on due investigation it should be found that the removal of this point is indispensable to the real improvement of the river, we submit that their Lordships should withhold their approval of any plan of improvement that does not contain a proviso for removing the Ooze End, either by the Corporation of Colchester or by the Channel Commissioners, as we are of opinion that this Point, together with Hound Point and the Old Lock, in their present state, are the greatest obstructions to the navigation of the river.

We are, &c.,
JAMES VETCH, *Capt., R.E.*
JOHN WASHINGTON, *Capt., R.N.*

To the Secretary of the Admiralty.

DUNDEE.
River Tay.

No. 318.

Walker, on Embanking the River Tay.

No. 318.

DUNDEE HARBOUR.—RIVER TAY.

Report of JAMES WALKER, Esq., F.R.S., *on embanking the Shore or Bed of the River Tay.*

Great George Street, Westminster,
21st January, 1845.

SIR,

The substance of the resolutions of the Trustees of the Harbour of Dundee is :—

1st. That I survey the dykes and other erections and operations of Lord Kinnaird and Colonel Paterson, on the bed of the River Tay, detailed in Mr. Leslie's Report to the Harbour Trustees, dated 24th Oct., 1843, and report my opinion, whether or not these erections, as they at present exist, are injurious to the navigation of the river; also, whether the effect of the erections and operations of the other proprietors, on the north side of the river, or all, or any of them, are injurious; and if so, that I describe the nature and extent of the injury.

2nd. That I report on the further effect, if any, of these erections and operations, supposing they were completed by embankments, so far as the foundations already project into the river; and,

3rd. That I state my opinion of the views embodied in Mr. Leslie's report of 24th Oct., 1843.

In August last I surveyed, generally, the river from its entrance upwards; and particularly the portion from the junction of the Tay and Earn down to near Dundee. I was accompanied by Mr. Leslie. Mr. Blackadder also, the engineer employed by Lord Kinnaird and Colonel Paterson, and whose able report I had previously received by his Lordship's orders, met me, and accompanied me during part of the survey. Afterwards I attended a Committee of the Trustees, when I stated the expediency of having the portions of the river particularly referred to surveyed and sounded; I also recommended observations to be made on the

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tides and fresh-water currents, with the sections and velocities at various places, from the entrance of the river to Perth, and upon the Earn. This was agreed to, and confided to Mr. Leslie, who, with his assistants, has completed the survey in a very satisfactory manner; so that independently of this inquiry, the plans and documents cannot fail of being useful to the trustees as further references. In October, Mr. Leslie and his surveyor, Mr. Knox, met me in Perth, when I examined the progress they had made, and directed some further observations and details. On the 12th December, by which time the surveys and observations were nearly completed, I again visited Dundee, entered with Mr. Leslie into the calculations resulting from the surveys, and had conferences with the trustees.

On the 14th December Mr. Leslie accompanied me to Perth, where Mr. Blackadder met us, and the various matters were discussed.

I have, in the course of the reference to me, had communications with Lord Kinnaird; and having informed the principal landowners when the plan was finished, that they might have the opportunity of seeing it, and offering any remarks, I have been waited upon at Dundee by Captain Allen, junior, of Errol, and Mr. Walker, Lord Kinnaird's agent.

On my visits to Dundee I have received detailed information as to the depths and tides below Dundee from Bailie Martin; also from the harbour-masters and Trinity-master.

I think it right to state the above in order to show that my opinions, which I am now to report, though they may be erroneous, have not been formed without ascertaining the facts that appeared to me to bear upon the question, or without hearing what those who are most interested or qualified had to say respecting it.

The duty of preserving entire the navigation of the River Tay has become much more important of late years, by the increase of trade that has taken place since docks were formed at Dundee; rendering the port, even in its present state, of almost national importance.

The character of the ten miles of river below Dundee is very different from all that is above it; and this was probably the motive that led to the town of Dundee being fixed where it is. The course, from the entrance of the river to opposite the docks, is nearly one straight line; the width ample, and clear of shoals, excepting at one point (the Horse-shoe Sand); and even there the deep water is one-third of a mile wide. The two extreme points, however, viz., the approach to the docks at the upper and, and the entrance to the river at the lower end, require the vigilant care of the trustees.

For the whole length opposite the docks there is very little more depth than upon the sill of the entrance; so that any diminution there would be attended with very injurious consequences. The trustees were obliged, in 1843, to dredge in front of the upper entrance to the harbour, in order to procure the requisite depth for ships entering; and a comparison of maps shows that the "Ballast Bank" to the westward of the town is extending downwards. Again, at the entrance of the river (the bar), there has been a constant struggle between the ebbing water from the river forcing the sand out of its way, and the waves of the sea trying to drive the sand back. Hence the Spits, and the Bar, and the shifting channel; which require a constant attention on the part of the harbour-master, to place the buoys of the entrance in the best situations for the deep water. It appears from information, and from the old charts,* that one hundred and fifty years since, and up to seventy years since, the best water out to sea was a continuation of the river course S. E. by E. half E. (the Croig or inner Lights "in one"); that then the extension of the Gaa Sand, on the north side, blocked up the straight passage to five or six feet at low water; that, as a consequence, the effluent water deepened a passage in the S.S.E. half E. direction (the present buoyed passage); that matters remained thus until fifteen or twenty years since, when the depth upon the tail of the Gaa Sand again increased. The Admiralty chart of 1837 (Captain Slater's) shows only eight and nine feet upon the Gaa Sand. There is now fourteen to sixteen feet, excepting upon small patches. At the same time the Abertay, or South Sand, appears to have been advancing again to the northward; and the recent shifting of the buoys has been in that direction. The Admiralty chart of 1833 gives sixteen feet upon the bar at spring tides. Mr. Jack, the deputy harbour-master, states it now to be eighteen; but the general result of the various information I received, and my conviction from that information is, that the depth of the entrance has not varied during the last century and a half. Adair's chart (supposed 1690) gives the depth upon the bar three fathoms in the straight line—the Gaa Sand then stretching out nearly east by compass.

These facts are named to show that there is nothing to spare; and that the cause, whatever it is, of the present depth should be watched with the most jealous care.

At Dundee the high-water width is one mile and a half. It contracts gradually to Broughty Ferry, three miles down, where the channel is through rock, and the width is only three-quarters of a mile; but three miles above Dundee we find it nearly three miles wide; and at ten miles higher up, it is still one mile wide—the average width being about two miles. Mr. Leslie calculates the area between Dundee and the mouth of the Earn at 17,800 acres, or 27¾ square miles. Where this widening, which is immediately above Dundee, begins, the shoals begin—there is no longer the straight, clear, deep, low-water course. On the contrary, four-sevenths of the area is dry at low water; and the three-sevenths that remain covered with water is shallow when compared with the river below Dundee.

In this description, a great similarity between the formation of the Tay and of the Mersey, from the sea to Runcorn, will be observed.

It is upon the north side of the wide, and therefore shallow part of the river, which is known as the "Estuary," that the erections and operations referred to, for embanking and reclaiming the soil of the river, between high and low water, have been carried on. They commence at the boundary of Colonel Paterson's estate (Castle Huntly), four miles above Dundee, and extend upwards in front of the estates of Lord Kinnaird, Mr. Hunter, of Seaside, Mr. Allan, of Errol, and Sir John Richardson, of Pitfour, at the confluence of the Tay and the Earn, which is fifteen miles above Dundee.

When the margin of the land was unprotected, and exposed to the wash of the waves during high winds, the water may be supposed to have been generally gaining upon the land, and enlarging the expanse of the water. Mr. Blackadder arrives at the same fact by the geological similarity of the strata. The level of the land close to the river being in most places upwards of twenty feet above high water, the quantity of alluvial matter that has been washed into the river, and then out to sea, in the course of ages may have been great.

I am not at all disposed to dispute Mr. Blackadder's geological theory of this; but it is clear that the water has now the possession, and has had it too long to be legally ejected; for the oldest charts show the width and margin of the estuary much as they now are.

As the ground increased in value, it became desirable to stop any encroachment of the water; and this was done by the erection of dwarf walls at the foot of the bank, to protect the loose soil.

The object and progress of the cross dykes, which are sloping walls of rough stone, projecting out at right angles from the shore, is stated by Mr. Leslie to have been, that they were begun by a former owner of Errol, as a substitute for the dwarf walls already named, which had been put up to prevent the waves from undermining and washing down the land into the river; and that the deposit between these dykes of the matter which is brought down the river by the freshes being the result of the same operation, the outer ends of the cross walls were connected by longitudinal walls, so as to entirely exclude the water, and convert into arable land the area which before was generally covered with water when the tide was up.

These enclosures have not prescription to plead in their favour. None of them are, as I was informed, more than ten years old; and the entire exclusion of the water even now is confined to portions in front of the Pitfour and Errol estates—the whole quantity being from one to two hundred acres. The fine quality of the ground that has thus been embanked has led Sir John Richardson and Mr. Allen to adopt measures for taking in land outside their first enclosures; and the other proprietors are following their example, by the erection of dykes and bush-fences (stakes driven into the ground and interlaced with wicker-work) in various directions in front of their estates. These, by interrupting the current, and, which is much more effectual, by interrupting and breaking the force of the waves upon the shore, and quieting the body of water that is within the dykes, form virtually traps or nets to catch and deposit the alluvial matter which is brought down the river, and is held in suspension while the water is in an agitated state.

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* The oldest chart is by Adair, a copy of which Mr. Blackadder has kindly furnished me with,

The longest of these dykes, until May, 1843, was 600 yards. At this time a new dyke was begun upon the boundary between Lord Kinnaird's and Colonel Paterson's estates. This one is already 1037 yards, or four-sevenths of a mile long, nearly one-fourth the whole width of the "Estuary," where it is the widest; and it is uncertain how much farther it is intended to be carried. Mr. Leslie has calculated that Lord Kinnaird's cross dykes may enclose three hundred and forty acres in front of his Lordship's estates. None of the other walls are of more than half the length of Lord Kinnaird's. But if walls were built to connect the ends of all of them, a surface of upwards of 1800* acres, or one-tenth of the area of the estuary between Dundee and the Earn, which is now open to the tide, would be embanked. Of this a portion near the shore, and between the dykes, and on the north side of Mudgrum, is already covered with reeds and salt grass; so that spring tides only rise over it. The average present depth of spring tide over the whole space, and which would of course be excluded if the ground were embanked, is eight feet. I say present depth, because the tendency of the dykes has already been to reduce the depth under what it was at the time of their erection.

A very leading question in the consideration of the matter is, whether, and to what extent, the depth and width of the river between Dundee and the sea is the effect of the occasional land-floods (the fresh water), or of the sea-water in its passage into the estuary with every flowing tide, and out of the estuary with every ebbing tide. To supply materials for correctly ascertaining this fact, was one of the principal objects of the surveys and observations that have lately been made; and the distinction should be borne in mind. In the Clyde, at Glasgow, the tidal current is not half a mile per hour. When the land-freshes come down, the velocity is four miles per hour. Therefore, the value of the tide at Glasgow, as a scouring power, is comparatively of little account. At Greenock, the reverse is the case; there the land-floods become unimportant as compared with the tide. It was therefore one of my objects, while designing the improvements of the Clyde, to keep down the dykes in the lower portion of the river, so as to prevent, as much as possible, a diminution of the tidal water at Port Glasgow or Greenock. So also in the cases of Liverpool, Yarmouth, Montrose, and many of our great harbours, which depend for their existence upon the tidal current, and where, therefore, the receptacle for tidal water ought to be preserved with jealous care. Now, what Glasgow is upon the Clyde, Perth is upon the Tay, dependent, so far as natural means are concerned, upon the river floods for its harbour; and as the discharge of the Tay is more than twice that of the Clyde, this natural power is greater at Perth than at Glasgow. In both cases the tide flows only two or three miles above the cities; and the rise or "lift" of a spring tide in the two harbours is nearly the same.

Let us now see the situation of Dundee, and endeavour to ascertain the relative value of the river and of the tide to that harbour.

I requested Mr. Leslie to take the opportunity of measuring the united discharge of the Tay and the Earn during a flood. The highest since then was on the 12th November, 1844. He states it to have been a full average flood; but that an extreme flood, after heavy rains, and a sudden melting of snow, would be four feet higher, when the discharge would therefore be considerably greater; but as these cases are not frequent, the November flood is considered sufficient for general calculation.

The discharge of the Tay was 753,740 cubic feet per minute.
Of the Earn 215,600 ,,
Together . 969,340 ,,

Say, in round numbers, one million cubic feet per minute; or two hundred and forty millions during four hours.

To compare the above with the effect of the tidal water at Dundee, I assume 15,000 acres as the average area (above Dundee) of the reservoir or estuary, during the first four hours of the ebbing tide, and the vertical fall of tide, during these four hours, to be 11 feet. This will give 7,187,400,000 cubic feet, or 30 times the 240 millions of river water.

To compare the effect upon the bar, the area of the river between Dundee and the bar must be added; and the tidal water upon the bar will then be upwards of 40 times the river water.

The small sectional area, or width and depth of the river above the estuary during a flood, compared with that below Dundee, is another proof of the great superiority of the tidal current. At Broughty Ferry (the most contracted point, owing to the rocky margin), the width and depth are each three times those of the river above the estuary; the sectional area is, therefore, nine times that of the river; and the velocity at Broughty is greater than in the river.

It is evident, therefore, that the effects of the river at Dundee are but feeble in comparison with those of the tide. It is only when they are reduced to figures in this way, that the vast disparity is seen; and the above calculations confirm what is stated by the pilots and others, that the difference between a spring and a neap tide is much greater than the difference between a tide with, and one without a land-flood; and that the current near the harbour's mouth is not perceptibly affected by a fresh, except at low water. I do not mean to say that the water of the Tay is of no use to the harbour of Dundee. On the contrary, besides adding to the quantity at all times, it forms a low-water channel through the estuary when the tide is out, and keeps clear that portion of it which the tidal water alone would not.

The idea of a gradual contraction of the river, from Broughty Ferry upwards, has been suggested as a desirable improvement. This would reclaim many thousand acres of fine land; it would also cause a quicker current through the contracted portion of what is now the estuary, and would improve the navigation of the river upwards (all in themselves useful and desirable objects); but it would ruin Dundee by depriving it of two-thirds of its present tidal reservoir. That the reservoir should be of a regular shape, with fair tapering sides, is not a matter of consequence, so far as Dundee is concerned. Quantity, at the proper time, is the consideration. The first cause of the current between Dundee and the bar is the sinking of the tide at sea; not the pressure from above. Indeed, the more slowly the water approaches to the point above Dundee, where its action is required, the better. The small velocity shows that but little of the head, or power, has been expended in arriving there. Therefore, even if the reduction in quantity caused by narrowing the estuary were to be restored by extending the length, this (as the average distance of the water would be increased), would not be so good as the present shape, which is nearer the circle, the best of all figures for the purpose, if gradually contracted at the outlet, in a balloon-like shape, to form an easy transition into the parallel or river shape before reaching Dundee, or where velocity is required.

It is true, that the sluggish current of the fluid in such a figure would tend to allow a deposit on the estuary; but it is a mistake to suppose that the depth of the estuary, except in and near the low-water channel, is the effect of the current. I consider it to be almost entirely the effect of the wash of the waves during high winds; and as a contraction in width is a certain way of reducing the waves and encouraging silting, I think it injurious. Were a gradual contraction to be made from Broughty Ferry upwards, the waves would cease to have effect in the space above Dundee; the current would become the only power. The width, thus reduced by art, would be still farther reduced by the natural formation of a fore-shore in the

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* Mr. Leslie states 1930 acres, which includes the spaces on the north side of Mugdrum, and the enclosed land in front of Errol.

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front of the dyke or bank, and this fore-shore would gradually rise above the level of the reclaimed land within the bank. Experience has proved this to be the progress in all similar cases.*

My opinion, on the point submitted to me by the Commissioners, must be in accordance with these principles; and that the reduction of the estuary by the proposed enclosures would be injurious to the harbour. Is this to such an extent as to be a practical evil? because, as has been said, and said truly, a single pile, if between high and low water, takes the place that would be occupied by water were the pile not there, and is, on principle or theory, an injury, although a thousand piles might not practically be so; and if they were not, there would be no useful object in preventing their being driven. That this is the feeling of the trustees, is indeed implied by their requesting me to report on the nature and extent of the injury I may anticipate.

As the extent of the exclusion of tidal water, by connecting the outer ends of the present dykes, so as to embank the space that would then be enclosed within them, is defined, and gives a basis for calculation, I shall take the liberty of considering this question first.

I have before taken the area which would thus be enclosed at 1,800 acres, or one-tenth of the whole estuary; but as the rise, or lift, of an average spring-tide is 16 feet at the lower, and 13 feet at the upper end of the estuary, or, on the average, 15 feet (having reference to the shape), while the present average depth over the space that would be enclosed is only about eight feet, the abstraction of water is not in proportion to the area, nor much above half this, or say one-twentieth of the whole cubic quantity, and therefore the question appears to resolve itself into this—Would taking away one-twentieth of the whole quantity of water that passes through the channel of the river at Dundee, or one thirtieth of the whole quantity that passes through the mouth of the river inside the bar, be a practical injury? I have no hesitation in answering both these questions in the affirmative.

Having before compared the whole of the tidal water passed out of the estuary with the water of a land-flood, a comparison between the latter (the land water and the water that would be excluded by the embankments) will give an idea of their relative value. The whole quantity of the united Tay and Earn that is poured into the estuary, and goes out with the tide during four hours of a land-flood, has been given as 240,000,000 cubic feet. Now, eight feet in depth over 1,800 acres gives 627,000,000; in other words, the 1,800 acres supposed to be embanked now add to the ebbing tide, at every spring tide, considerably more than two and a-half times the quantity supplied by the rivers during four hours of a land-flood; or, in other words, if the river water were to be turned into an enclosed space of 1,800 acres, it would require ten hours to raise it to eight feet in depth. Unless there is some fallacy in these figures, it seems difficult to come to any other conclusion than that connecting the ends of the dykes would be injurious to the harbour.

In the instructions to me, the operations of Lord Kinnaird and Colonel Paterson are distinguished. The quantity, by connecting their dykes in the shape described by Mr. Leslie, would be 340 acres, or nearly one-fifth of the whole. The cubic contents, at eight feet deep, is 118,000,000, so that this surface alone supplies more to the ebbing current than two hours of a river flood would do.

It is impossible, then, to give the opinion I have done as to the whole, and to give a different opinion on the abstraction of so large a proportion. And it is to be remembered, that the spring-tides occur about four times in every two weeks, and are, therefore, much more frequent than the river floods. I think that the November flood is the only one that has occurred for many months.

The above calculations are taken on an average depth of eight feet. It is almost unnecessary to say that the portion near the foot of the bank, which is covered with sea-grass and reeds, and is now but little under the high-water level of spring-tides, contributes but little to the quantity, so that the injury done by enclosing this alone would be but small in proportion; indeed would not come within what I have described as being practically injurious. I had no correct means of ascertaining if these reed shores existed anywhere before the dykes were begun, or if they were the effect of them. If the former, it would appear that, in such places, the land had been naturally rather gaining upon the water. This is a matter for evidence. There can be no doubt, however, that the erection of the dykes has increased, if not formed, the growth of reeds, for which only a particular level below high water is suitable.

In the calculations I have made, and the opinions I have founded upon them, I have included only the space that would be enclosed. The silting effect of the embankments upon a portion of the large space also, that would be left between the outside dykes and the low-water channel, would, though gradual, be certain, and in the end considerable. I have already referred to it as arising from the contraction of the width and consequent quieting of the surface, or "laying" of the waves, to which, and not to the current, the depth is due; and I am desirous of having this understood, as the contraction of the estuary has been prescribed for deepening it which it cannot, in my opinion, do, unless the width be so reduced as to be kept clear by the river water quite up to the banks; that is, unless the estuary be entirely done away with. In advising as to embanking in other places, I have acted upon this principle, not recommending the whole intended finally to be reclaimed to be enclosed at once, but only a partial measure to encourage a silting in front of it, and to make the embanking of the outer portion more easily accomplished afterwards. I have no reason for suspecting that the landowners have this in view; that they see in the 1,920, or the 1,800 acres, only a first instalment; but the fact will be, that the unenclosed ground, particularly towards the upper end (Sir John Richardson's and Mr. Allen's), will, after a series of years, be more easily embanked; and from the gradual accretion upon its surface, the abstraction or enclosure of a further space will then become of less consequence to the interests of navigation, just as the present reed shores have become, or at least now are.

My desire to avoid, in this report, all that is not really practical, must not extend to prevent my saying that the injury done by any diminution of the power which scours the rivers and removes obstructions, is not simply in proportion to the quantity abstracted. It is in a greater proportion; that is, if you take away any, say half the quantity of the water that now keeps the river open, although, by doing so, you reduce the velocity only one-half, you take away much more than half the power. Every one used to canal or river navigation knows that very much less than one half, or even less than one-*fourth*, the power is required to draw a boat or other body through still water, at one mile per hour, than at double the speed,† and also, which is indeed the same thing, that very much less than half the power is required to hold a body at rest against a stream which runs at the rate of one mile, than against a stream of two miles per hour. And the same principle extends in a degree to the power of rivers to widen and deepen their channel.

Mr. Blackadder states in his report, that, according to Mr. Jardine's survey of the Tay in 1810, "the estuary does not fill up level with water, and that the medium depression between Broughty and Newburgh is 15 inches below that of the tidal waters at its confluence;" and he gives the opinion of a gentleman, high in physical and mathematical science, to whom a similar case had been submitted; which was, that "there could be no sensible exclusion of tidal water, when the internal estuary did not fill up level with the external tideway at high water."

This was an opinion on a particular case, and there is always danger in generalizing from particular cases. As Mr. Blackadder says the Tay is similar, I have his respectable authority for its being so. May it not, first, be fairly inferred from this, that Mr. Blackadder and the gentleman he consulted, thought that the tendency of any operation which excluded water was injurious; and that the reason why injury in the case Mr. Blackadder referred to him was not done, was because there was no exclusion of water? Now, in the

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* It is fair to Mr. Blackadder to say, that the opinion he has given, as to the embanking not being injurious, has reference to the enclosures that would be effected by the present dykes, and not to any such extensive contraction as I have here referred to.

† The increase of power during the time it is exerted, is as the cube; that is, if the velocity be doubled, eight times the power must be applied, and, of course, double the distance will be gone over in the same time.

APPENDIX B.
Supplement.

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case of the Tay, it must be evident, without another array of figures, that if the estuary were contracted until this depression were filled up, a very much greater quantity of the contents of the estuary or reservoir must be taken off than would fill the depression; or, to take the abstraction of 1,800 acres (the subject matter of our inquiry), would this abstraction lessen the present depression one inch in the deepest part, or half an inch over the surface depressed? Probably not; but even if it did, this would not be one-twentieth of the quantity that would be excluded by the embankment. Indeed, if Mr. Leslie's section be taken as a basis, the proposed enclosure of 1,800 acres would alone exclude twice the quantity of the whole depression.

On referring to Mr. Jardine's section, I see that the greatest depression is opposite Flisk Church, where the water is eight inches lower than at Broughty; that the Broughty level is attained again opposite Inchyra, and that the average depression from the sea is about 12 inches.

Mr. Leslie's recent survey makes the greatest point of depression to be at Dundee, where it is eight inches and a half lower than at sea. So soon as it enters the estuary, the inclination is upwards, tending to restore the depression. Nine miles above Dundee the Broughty level is regained. At Inchyra the sea level is regained; and at Perth the tide is 10 inches higher than at sea. I have confidence in Mr. Jardine's and Mr. Leslie's accuracy, and conclude that the variation in the two sections is from their having been taken at different states of the river, or more probably of the wind.

A very large diminution of the estuary must take place before the sea level could be carried through—it must be something like a regular contraction from Broughty Ferry upwards; and what I have said on that subject is, I hope, sufficient to show how injurious the effect of this would be. At the same time, I quite agree, that if the sea level could be carried throughout, or exceeded, as is the case in some rivers, this would be desirable, if it could be done without a concomitant evil. The real would not, however, be so great as the apparent benefit, because the loss of water by the depression is at the top of the tide. The first half hour's ebb restores the level; and this is long before the current has acquired such a velocity as to be useful for a scour. Again, whether Mr. Jardine's or Mr. Leslie's levels be taken as correct, it appears that nearly all the depression takes place between the sea and Dundee; in other words, that the throat or gorge of the estuary is not large enough; and Mr. Blackadder will, I think, agree with me, that it would be better for Dundee to endeavour to get rid of the depression by enlarging the throat than by diminishing the estuary. The narrowest point is at Broughty, where an enlargement would be useful. The sides being rock are not moved by the velocity, great as it is. If from buildings or otherwise, an artificial widening cannot be obtained, the greatest care ought to be taken that the water-way at Broughty be not encroached on. I name this, because some operations appeared to be carrying on there; and whatever is done should be carefully attended to. A diseased throat is perhaps as dangerous as a disordered stomach.

Having thus stated, at perhaps greater length than may be thought requisite, my reasons for thinking that enclosing the whole spaces between the ends of the dykes, whether those of the different land-owners, or of Lord Kinnaird and Colonel Paterson only, would be injurious, it follows that the dykes and other operations of Lord Kinnaird and Colonel Paterson, as well as of the other land-owners, which have, in their present state, the affect of causing a deposit af soil, thereby raising the surface and lessening the estuary, are injurious also. To what extent this has already taken place, I have no means of judging. The levels now taken by Mr. Leslie, under my direction, being the first, there is nothing to compare with. The deposit in the Dundee basins was stated to be at the rate of 16 inches per annum. In these, the depth of water is greater than upon the shore of the estuary, and there is no wash or wave in the basins to disturb the mud after it has deposited in them, as there is upon the shore of the estuary, until the reeds grow. Perhaps four inches to six inches per annum over the whole surface may not be far from the truth. Having stated the cubic quantity of water which would be excluded by the entire embanking out of the tide, the effect of any gradual deposit will be in proportion to the depth, so that the calculation is simple; but I am unwilling to prejudice the question by stating quantities from uncertain data. Undoubtedly the silting operation is in progress; indeed, the dykes and other works have been made for the purpose of silting, and as a preparation for the entire exclusion of the water. This the land-owners will not deny; nor, as gentlemen, will they be disposed to defend the process or gradual steps towards an object, if the object, when perfected, be proved to be injurious. I am not aware when they were first made acquainted with the objections to the embanking on the part of the trustees of Dundee Harbour. If this was before these expensive works were done, the wrong has been theirs, and there will be less sympathy with them. If no notice was taken of their proceedings, this is to be regretted. I quite agree with Mr. Leslie that the interests of Perth and Dundee are not "as one" in the matter; and I apprehend there is no doubt of this, that even if the Perth authorities are the conservators of the whole river, their approving or not objecting would not legalize what could be shown to be injurious to the navigation up to Dundee. It is to be hoped that the improvement and extension of Perth Harbour can be effected without prejudice to the lower navigation. Messrs. Stevenson, the engineers to the Perth Commissioners, do not, in any of their reports I have seen, refer to a contraction of the estuary as part of their plan. On the other hand, the trustees of Dundee Harbour can have no wish to prevent an improvement of the estates adjoining the river, if it does not involve an injury to the navigation.

The opinion that a regular fair line between the river and the land would create a current, and be a better preventive to the deposit than the present very irregular line, has been stated by one of the gentlemen most largely interested.* Agreeing with him, as I do, that there is at present no current upon the sides of the estuary, at either flowing or ebbing tide, to prevent deposit, I feel equally certain that the connecting the ends of the dykes will not practically alter the case; and I think I have said enough to explain why I feel so, viz., that the disturbing cause is not the tidal or river current, but the wash of the wave; and I really believe that much of the difference of opinion arises from what I consider a mistaken view on this point. The difference between the clear state of the water on a calm day, as it approaches or leaves the shore, and the muddy state on a day when there is any wave, or even the surface ripple or "jabble," is proof of this.

In his report Mr. Blackadder refers to contractions or enclosures upon the Clyde, and upon the Ouse, at Lynn, as having been accomplished without injury to the harbours.

I have already stated that, upon the Clyde, provision was made by me not to exclude the tidal water, while the navigable channel was to be straightened and deepened by artificial means, which would be the least objectionable; indeed, so far as I can see, an unobjectionable way of improving the navigation in the upper part of the Tay.

The Harbour of Lynn was surveyed by me and reported on in great detail in 1825. After the completion of the Eau Brink Cut, to which Mr. Blackadder refers, the harbour was improved in some respects, in others the reverse. On the whole the balance was favourable. The new works consisted in substituting a straight and deep for a narrow and tortuous channel, in a shallow estuary, which caused cross currents in the harbour; and in deeping and enlarging the river Ouse for many miles up the country, by which the quantity of effective tidal water was increased.

A reference to Mr. Telford's published account, or to the living evidence of Mr. Gibb, will prove that this was also the case with the Dee at Aberdeen; and I believe that the Forth, the only other river named by Mr. Blackadder, would not, were the particulars known by me, be found in opposition to the general principle,—the laws of nature being general. Mr. Blackadder, however, knows another Dee (the Chester river), and other harbours, where embanking has been very injurious; and I think I might be able to convince him that the principle of tidal or back-water, upon which I have based my opinion, is applicable to

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* Captain Allen, R.N., younger, of Errol.

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Supplement.

DUNDEE.
River Tay.

No. 318.
Walker, on Embanking the River Tay.

Dundee; and that the supposed exceptions are to be accounted for, by applying that principle to harbours which depend on other causes; as, for example, to the Harbour of Perth, for which a contraction from Dundee up to Perth would be beneficial, although, from being attended by a great diminution of tidal water, it would be injurious to Dundee.

The third query, as to my opinion of the views embodied in Mr. Leslie's report of the 24th October, 1843, will be more distinctly ascertained by a reference to his and my report. It will, I think, be found that in principle our opinions do not differ. I have avoided repeating those details which are very fully and clearly stated by Mr. Leslie; and in taking generally the quantities, which form the ground-work of my opinion, somewhat lower than he has done, my object has been, not to dispute his correctness, but to take the low side where the data are uncertain.

Neither of us would, I am sure, object on principle to a judicious mode of marginal embankment, cutting off all the sinuosities which Mr. Blackadder recommends, if it be done without an injurious reduction of the tidal water: but I am convinced that no embanking could be formed to such an extent as to effect a scour upon the sides of the estuary, without serious damage to Dundee.

I am, Sir, &c.,
JAMES WALKER.

To George Milne, Esq.,
Clerk to the Trustees of the Harbour of Dundee.

ARBROATH.

No. 319.
Memorial of the Harbour Trustees.

No. 319.

ARBROATH.

The Memorial of the Trustees of Aberbroathwick Harbour, in the County of Forfar, to the Tidal Harbours Commissioners.

A SHORT time ago the memorialists submitted to your Honourable Board a statement of circumstances connected with Aberbraothwick Harbour, in support of an application made by them for aid from Government to enable them to deepen the harbour and its entrance. This application was favourably entertained and reported on, but has not yet been disposed of

An occurrence took place lately which strongly supports the memorialists' claim for Government assistance, and the memorialists beg most respectfully to bring it under your notice.

On Tuesday, the 19th of August last, a strong gale from the north-east, with heavy sea, prevailed along the whole east coast, and it increased so much that night and the following day, that a fleet of herring-boats in the Moray Firth were driven to seek shelter and safety in the nearest harbour. They were unable to take Peterhead. They then tried to take Aberdeen, but failed, the first boat that attempted it being wrecked. They were equally unsuccessful at Stonehaven and at Montrose, and they were driven onward for Arbroath. The whole coast near to Arbroath seemed covered with them, and as the sea was running very high, and the gale unabated, there was great excitement in the town, and much fear entertained of a disastrous result. Several of the boats were near enough the shore to make it apparent that the crews were almost exhausted and in extreme distress, and the life-boat was got in readiness and other measures adopted in case of the worst. Providentially the whole of the boats, 22 in number, took the harbour in perfect safety.

There were five other vessels in sight at the time, two of them foreigners, which seemed determined to run for Arbroath Harbour, but there was not sufficient depth of water, and they were warned off by signals from the shore.

The memorialists are well warranted in stating, that had the harbour and entrance been deepened, as proposed, these vessels might without difficulty have obtained shelter in the same way as the herring-boats did, and the risk they encountered by being compelled to remain at sea during the storm would have been saved.

The case of Aberbrothwick Harbour is now most urgent. The memorialists are confident that there are abundant public grounds to justify the Government in granting the aid applied for, and they venture to solicit your Honourable Board to give the application such further support as may appear to you proper.

Signed in our name, and by our appointment,
JAMES GIBSON, *Chairman.*

September, 1845.

No. 320.
Letter from W. Leask to the Harbour Trustees.

No. 320.

Letter from WILLIAM LEASK, *Master of the Barque "Hants," of Aberdeen, to* Messrs. LOUSON and MACDONALD, *Clerks to the Aberbroathwick Harbour Trustees.*

GENTLEMEN, *Arbroath, 29th September*, 1845.

I think my case so hard that I cannot help making a complaint to you, to be laid before the Arbroath Harbour Board.

I arrived off Arbroath with my barque, the "Hants," of Aberdeen, burthen 230 tons, having a cargo of wood from St. Johns, on the 19th current. I expected to get into the harbour, and attempted it, but failed, there being an insufficient depth of water, though, to a small extent, which was the more annoying. I tried to lighten my vessel, but I could not succeed, owing to the roughness of the sea. I was obliged at last to run into the Tay and lighten her there; and it was only this day that I got her into your harbour. This has been attended with great expense and heavy loss to me. My costs out of pocket I estimate at not less than 80*l.*, being part owner of both ship and cargo.

I think, under these circumstances, that some consideration ought to be given to my case. The neglect or delay to deepen the harbour and the entrance to it is the sole cause, and there ought to be redress given.

I am, &c.,
WILLIAM LEASK.

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Supplement.

No. 321.
De la Beche, on Estuaries and their Tides.

No. 321.

Memorandum on Estuaries and their Tides, by SIR H. T. DE LA BECHE, F.R.S., F.G.S., *&c.*

10th June, 1843.

THE existing state of any estuary, or tidal river, may be considered as an adjustment, for the time, of certain conditions, changes in any of which conditions effect alterations in that state, productive of injury or benefit to the purposes for which we employ, or may be desirous of employing, such estuary, according to circumstances.

The action of a flood-tide in an estuary, or tidal river, is to pond back, during its continuance, the river waters, which would otherwise have flowed outwards for that time; so that when the ebb-tide makes downwards, the tidal waters, which came up with the flood-tide, are increased by the volume of water so ponded back, independent of the ordinary discharge of the river waters during the ebb.

The ebb-tide, therefore, is composed of the tidal waters which came up with the flood, *plus* the water ponded back, and the river water continuing to flow out during the ebb.

It follows that the mechanical effects produced on the bottom of an estuary by the ebb-tide must be far greater than on the flood, and that there is a constant tendency to force mud, silt, sand, and gravel outwards to the sea.

The mode in which these substances, commonly termed *detritus*, are carried along is twofold:— First, when the movement among the particles of water is sufficiently considerable, the water will take up the detritus in mechanical suspension, as it is termed, according to the amount of this movement; that is, the detritus is really lifted up and borne onwards actually suspended in the water. Secondly, the mud, silt, sand, and gravel, as the case may be, will be pushed or forced along, upon the bottom, according to the pressure and velocity of water above them, producing the friction required.

It follows, where there are unequal velocities of waters in tideways, that the same substances which may be mechanically suspended in the water in one place will be thrown down on the bottom in another; and that in situations where the water remains for any sufficient time at rest, such places will be gradually filled up by deposit of the substances mechanically suspended in the water flowing into them.

In like manner, also, substances which are pushed or shoved onwards along the bottom by the weight and velocity of the water above them in some situations, come to rest in others, when such weight and velocity are sufficiently diminished.

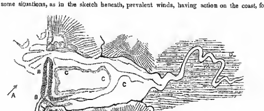
As the volumes and velocities of tides in estuaries vary, and the amount of water falling into them varies also, from the comparatively small streams in dry weather to the heavy volumes discharged during freshets or floods, the mechanical action on the bottom of the estuary is necessarily variable, always allowing for a constantly prevailing action outwards, and unless there be sufficient compensating forces, general changes will be effected according to those conditions which are dominant.

As there is no sufficient force to counteract the discharge of detritus outwards, this will accumulate in the estuary, if the ebb tide be not able to force it beyond into the sea.

The amount of detritus thrown into the estuary will depend on the course of the river above it. If that course be rapid to the tideway, and the water capable of forcing forwards gravel, all minor detritus will be borne down, and the whole will be discharged into the estuary, to be dealt with according to its powers. And this is the general action in all kinds of river courses, down to that which permits the river waters simply to bear the matter of mud to the tideway, in which the velocities may even be sometimes greater than in the river above.

The banks across rivers formed where detritus, either mechanically suspended or pushed onwards, is brought to rest, from a discontinuance of the conditions necessary to suspend or move it, and commonly known as bars, occur, as might be expected, very variously in rivers. When arms of the sea, gradually diminishing inland, terminate in estuaries, these bars are often far up the tideway, where the rush of river waters in a freshet is met by the quieting action of the tide; in other tidal rivers the bars occur at their embouchures, where the action of the breakers not only tends to force the detritus back upon the coast, but also stops the velocity of the estuary waters discharged on the ebb.

In some situations, as in the sketch beneath, prevalent winds, having action on the coast, force



breakers along shore also in a prevalent direction, A A, causing a beach, B B B, to follow a line along shore, and across the mouth of the estuary; so that a formidable barrier to the discharge of the river-borne detritus, seaward, by this and the other causes above noticed, is presented, behind which shoals, C C C, accumulate, tending to fill up the lower part of the estuary, alluvial flats forming above, D D.

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From the action of breakers on a coast, (a most powerful action, throwing up shoals and bars at their embouchures,) combined with the loss of velocity of the estuary waters seaward, depositing the detritus they can no longer transport or push onwards, estuaries as a whole are filling up, some slower, some faster, according to conditions; a fact which, though not always apparent in some places during what have been termed historical times, is abundantly shown in others, and, when considered geologically, satisfactorily proved.

New channels may be formed from an increase of deposit in one place, giving a new direction to the waters in another; and it is highly instructive to observe how an apparently very small cause may produce important modifications and alterations, changing the channels and shifting the banks or shoals; but the general resulting action is a filling up, viewed as a whole.

Such are the variable conditions existing in estuaries, and so complicated are often the effects of the causes in action, that it becomes of the utmost importance well to study and reflect upon the value of each cause before we attempt changes in connexion with an estuary intended for our advantage; and this more especially when a great commercial port is situated on part of such estuary.

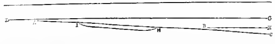
It will be obvious, if bridges traverse an estuary, that not only will the piers stop the tide flowing upwards (in proportion as the piers occupy the breadth of the river), thereby bringing the head of the estuary more seaward, but that these obstructions would tend to produce shoals in the bed of the main channel; for though the ebb, with its back-ponded river waters, would pass between the piers with great velocity (because passing through what may be considered as a dam pierced in many places), scooping out corresponding channels, deposits would be formed in the eddies behind the piers, the influences of which are prolonged into the main channel.

It will also be readily seen, that when the strength of a tide impinges on a bank (sufficiently hard to prevent its being worn away), that any artificial alteration in the form of that bank would produce a change in the direction of the tide, the shoal-forming or channel-scooping influences of which will be felt in proportion to the amount of change so made, due regard being had to the new effects produced as well upon the flood as upon the ebb-tide.

As at any given time the forms of natural banks in estuaries are but adjustments to the general conditions existing at that time, it follows that, if these forms be artificially altered, this adjustment is destroyed, and a new state of things arises, which may be considered local or otherwise according to the amount of change. In strictness, viewing an estuary as a whole, and the effects produced by changes of this kind upon the two tides, that which may appear of very little importance should be considered as, to a certain extent, producing general results.

As the velocity of equal volumes of water in rivers depends on the amount of fall of their channels or courses, and as the same necessarily holds good in estuaries, to that level which may be considered as low water (when such is not outside, the whole estuary being above real low water on the coast), the fall of the channel of the estuary from its head to this level, all other things being equal, gives the general velocity of the waters of the ebb-tide; whence it follows that whatever scour or mechanical action of the water on the bottom may be due to the influence of this fall, it cannot be altered, as a whole, so long as these two points remain at the same distance from each other, and the difference of their levels is constant, equal volumes of water being understood.

Let, in the annexed sketch, the line D A B C represent, at an exaggerated angle, the bottom of part of a river, above an estuary, the bottom of the estuary itself, and a portion of the sea bed; the line G A being that of high water in the estuary, and E B that of low water; and let A B be the bottom of the estuary, and B C a part of the sea bed beyond it.



So long as A, the head of the estuary, and B, the level of low water, remain at the same distance, and at the same difference of level, and the volume of water passing down, or rather the excess of influence of the ebb-tide over the flood, viewed as a whole, be a constant, any deepening of the bed of any part of the estuary, as, for instance, at H I, will, it is obvious, not alter the amount of the general slope from A to B, for the influence of any extra water lodged in the cavity H I, so long as H retained its height, supported by the bottom H B C, would be nothing as to scour of the bed, since it would merely constitute a pond or pool in the general channel, that would be again filled up by detritus brought down from above, in the usual way, along the bottom D A I.

Assuming that the action of the tidal water introduced at the flood-tide is as great upon the bed of an estuary as during the ebb, the same volume of water, viewing only the tidal water, passing in and out,—an assumption not strictly correct, inasmuch as the flood-tide flows up an inclined plane and the ebb runs down it,—but, for convenience, assuming this action to be equal, we should anticipate that when the back-ponded river water can be let loose upon the ebb, the greatest scouring effects outwards would be when the volume and velocity of the united waters, viewed in combination, should be the greatest, and that that would be not immediately after high water, when the pressure of the supporting tide is slowly removed, but towards the middle of the tide, when (though the volume was greatest nearer high water) the velocity was so much increased, as, with the volume of water still remaining, to produce the greatest effects. This anticipation is borne out by observation, which appears to show that from about two to four hours' ebb the greatest scour of the estuary bed is effected.

All observation tends to show that the greater the volume of tidal-water coming up an estuary with the flood, the greater is its mechanical or scouring action when its volume and velocity are increased by the addition of the ponded-back river water, and the ordinary river discharge. And it should be borne in mind that it is only during the ebb that the river-water passes out as a whole, though in some estuaries, during heavy freshes, the river-water, from its less specific gravity, has been known to run downwards on the top of the flood, coming upwards: proved by large vessels, such as men-of-war, drawing several feet of water, riding an anchor with their heads to the first of the flood-tide, while boats alongside, drawing little water, laid with their hands up stream against the freshets. It may be here observed, that when conditions are favourable, the flood-tide running in, lifts the outgoing ebb, particularly when composed of little else than river-water, in a wedge-like manner. From

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this to the conditions where the flood suddenly overcomes the ebb-tide by a great wave, or bore, as it is termed, there are various modifications.

Much mischief has been found to be occasioned in estuaries, by embanking, producing sensible effects even when portions only covered at spring-tides have been taken for agricultural purposes. When it is considered that the weight, for friction purposes, arising from volume of water combined with the requisite velocity, causes any given amount of scour or mechanical action on the bed of an estuary, it follows, that if we stop out the tide, diminishing the volume of water, even supposing, for convenience, that the velocity remained the same, which would not be the case, the scour or mechanical action cannot be the same as previously, and that, this action, being diminished, detritus which would have been swept onwards under the former conditions would now remain and accumulate.

It may be here observed that, in estimating the power of the combined action of volume and velocity of water to produce scour or mechanical effects on the bottom of an estuary, great care should be taken to ascertain the real velocity where the waters come into contact with such bottom, shoving and pushing detritus onwards, otherwise very erroneous inferences may be drawn. Certain mechanical effects are considered to be produced by the action of given velocities of water. Without entering upon the question of how far the experiments made may appear to justify the conclusions drawn, it will be obvious that, whatever action may be due to the velocity of water alone, if the velocities on the surface of the main stream of tide at certain times are only known, and those at the bottom, from considerable friction, are much less, calculations as to scour, founded on the surface velocities (those usually alone known to mariners and others engaged in the navigation of estuaries) cannot be accurate.

Although much injury would be occasioned by stopping out the entrance of effective tidal waters in estuaries by embankments, it does not follow that judicious arrangements may not be made with them, so that one greatly improved general course may be obtained for the waters, and a main channel formed of increased value for the purposes of navigation; the loss of water occasioned in one place being compensated by contrivances for allowing a greater volume to come into another, so that the total effective water remains the same, a provision usually considered when improvements in estuaries are under investigation.

Again, upon the principle of letting out a volume of water to scour when it can have the greatest useful velocity, and produce the greatest mechanical effects on the bottom,—a principle, however, which requires great care and consideration in its application when the channels to be scoured are long,—waters may be retained behind embankments employed for giving a general direction to the main channel, and used for roads, or otherwise, until the most favourable time of tide, then to be thrown into the main stream, so that the volume of ebb waters may even be larger at that time than prior to any embanking on the river.

These are, however, subjects requiring great local care and study, and are merely mentioned to show that artificial improvements could readily be made in estuaries without diminishing the effective action of tidal waters, if these be so managed, and the general arrangements such that their useful powers be not deteriorated.

H. T. DE LA BECHE.

APPENDIX B.
Supplement.

ENGLAND AND WALES.

No. 322.
Abstract of Port and Harbour Debts.

No. 322.

ABSTRACT of the AMOUNT of DEBT of certain Ports and Harbours, due on the 1st of January of the several Years 1842-43-44-45-46; and the proportion which the Debt bears to the Income thereof.

Ports, Harbours, &c.	Debts due on the 1st of January,					Gross Income for the Year 1845.	Proportion of Debt to Gross Income of 1845.
	1842	1843	1844	1845	1846		
ENGLAND and WALES.	£.	£.	£.	£.	£.	£.	
Aberystwith	12,194	12,394	12,919	12,919	12,919	1,205	10·0
Arundel	2,600	2,600	2,200	2,200	2,200	1,687	1·3
Barmouth	1,780	1,980	1,980	2,080	2,080	206	10·0
Berwick-on-Tweed	12,725	14,050	13,375	12,700	12,025	2,217	5·4
Boston	9,250	8,100	6,950	12,000	11,400	4,139	2·7
Bridlington	5,388	5,098	4,625	12,145	15,000	3,264*	4·6
Bridport	24,900	25,000	25,000	25,000	25,000	2,086	12·0
Bristol (Harbour and Docks)	594,041	594,041	594,041	594,041	594,041†	33,509	17·7
Brixham	3,856	3,460	3,460	3,460	4,330	750	5·8
Bude	22,244	21,244	20,244	19,244	18,244	136	134·1
Burry Port	2,805	2,256	1,767	759	616	365	1·7
Carnarvon	3,962	4,155	4,121	3,893	3,880	1,576	2·5
Dover	50,700	45,600	44,000	42,400	40,800	12,315*	3·3
Fleetwood	66,000	66,000	66,000	66,000	62,000	834	74·3
Grimsby	12,000	12,000	12,000	12,000	Paid off‡	1,766	..
Guernsey, St. Sampson	6,980	6,951	8,660	9,657	9,657	508	19·0
Hartlepool	16,000	16,000	16,000	16,000	16,000	2,679	6·0
Hull (Harbour and Docks)	42,154	16,654	5,304	85,100	156,436	42,336	3·7
Ilfracombe	744	720	720	711	661	164	4·0
Ipswich (Port and Dock)	75,697	89,725	104,160	108,000	108,500	8,461	12·8
Jersey	..	..	..	3,982	11,316	5,141	2·2
Lancaster	4,100	4,100	4,100	4,100	4,100	1,326	3·1
Liverpool (Port and Docks)	1,443,156	1,676,675	1,829,895	2,043,293	2,475,691	235,776	10·5
Lyme-Regis	2,200	2,740	2,640	2,540	2,440	945	2·6
Lynn	13,500	16,000	14,600	12,900	11,450	4,817	2·4
Man, Isle of	2,350	2,850	5,550	6,890	6,890	2,300	3·0
Margate	67,200	67,200	67,200	67,200	67,200	9,051	7·4
Maryport (Harbour and Docks)	21,345	21,345	21,345	21,345	33,345	3,067	10·9
Neath	..	..	6,000	6,000	8,400	1,044	8·0
Newhaven (Dock)	5,700	5,700	4,900	4,900	4,000	2,965	1·4
Newport (Monmouthshire Docks)	85,000	85,000	85,000	85,000	54,118	6,086	8·9
Newquay (Aberystwith)	1,000	1.000	1,000	1,000	1,000§	220	4·5
Preston	4,019	4,370	711	8,147	14,343	2,493	5·8
Rye	1,500	1,500	1,500	1,500	1,500	1,552	1·0
Southampton	12,312	12,312	12,312	12,312	12,312	3,884	3·2
Southwold	987	987	987	987	987	1,162	·8
Spalding	14,000	18,750	19,500	19,250	19,000	4,704	4·0
Stockton	43,505	41,204	42,136	41,970	42,002	9,235	4·5
Sunderland	31,584	35,215	35,055	41,054	43,860	15,398	2·8
Swansea	48,872	62,322	82,542	89,742	93,442	6,529	14·3
Teign River	800	800	800	800	800	151	5·3
Teignmouth	5,500	5,500	5,500	5,500	5,500	686	8·0
Tenby	..	2,000	2,000	2,611	2,400	474	5·1
Warkworth	3,693	20,113	21,812	60,000	68,288	483	139·9
Wells	2,844	3,043	3,709	8,260	11,161	642	17·4
Weymouth	20,000	20,000	19,800	18,300	18,300	1,802	10·2
Whitby	16,132	17,920	18,087	18,244	21,175	3,336*	6·3
Whitehaven	56,006	56,696	56,696	56,696	56,696	7,216	7·8
Wisbeach	..	..	..	..	2,500	1,996	1·3
,, River Account	16,000	14,000	12,000	10,000	6,000	3,992	1·5
Workington	9,301	9,474	9,308	9,227	8,945	1,206	7·4
Yarmouth, Great	600	..	..	..	..	12,312	..
Yarmouth, South	..	300	300	300	300	21	14·3
Total England and Wales	2,899,226	3,157,144	3,334,451	3,704,359	4,205,250	472,220	8·9

* Bridlington, Dover, and Whitby, are in receipt of a passing toll.
† At Bristol, on 13th of May, 1846, the sum of £75,590 was in hand for the redemption of the debt.
‡ At Grimsby the debt was paid off by the New Dock Company.
§ At Newquay (Aberystwith) £8000, raised by subscription, has been expended on the harbour.

APPENDIX B.
Supplement.

SCOTLAND.

No. 322.
Abstract of Port and Harbour Debts.

Abstract of the Amount of Debt of the following Ports and Harbours, due on the 1st of January of the several Years 1842-43-44-45-46—*continued.*

Ports, Harbours, &c.	Debts due on the 1st of January,					Gross Income for the Year 1845.	Proportion of Debt to Gross Income of 1845.
	1842	1843	1844	1845	1846		
SCOTLAND.	£.	£.	£.	£.	£.	£.	
Aberdeen	175,085	172,412	179,525	177,820	186,676	28,783	6·5
Arbroath	21,860	32,800	48,637	51,226	53,514	2,594	20·6
Ardrishaig and Crinan	1,416	1,487	1,554	1,521	1,591	248	6·4
Ayr	2,841	2,714	2,485	2,630	2,171	1,964	1·1
Banff	7,621	8,043	8,069	8,110	8,201	721	11·4
Borrowstowness	..	1,858	2,490	2,507	2,400	417	5·8
Burghead	20,000	20,876	21,680	22,484	23,369	345	67·7
Burntisland	500	500	500	500	500	436	1·1
Campbeltown	1,395	1,395	1,395	1,395	1,395	180	7·7
Dumfries	6,709	6,418	5,973	5,603	5,005	1,433	3·5
Dunbar	4,554	4,837	5,100	5,555	5,832	291	20·0
Dundee	232,217	235,247	234,150	229,090	224,150	24,478	9·2
Eyemouth	500	500	1,700	2,473	2,200	217	10·1
Fisherrow	5,400	5,500	6,040	7,185	7,218	476	15·2
Fraserburgh	2,426	2,426	2,426	5,196	12,496	787	15·9
Garliestown	275	275	575	565	555	115	4·8
Glasgow	168,663	219,119	282,416	319,397	320,006	46,865	6·8
Gourock	2,000	2,000	2,000	2,000	2,000	389	5·1
Greenock (Harbour and Docks)	60,811	63,254	66,031	63,752	57,604	13,960	4·1
Irvine	132	612	614	634	1,072	357	3·0
Kirkaldy	209	54	3,737	8,197	9,963	1,557	6·4
Kirkwall	1,118	1,047	934	880	779	119	6·5
Leith	228,374	228,374	228,374	228,874	228,374	20,457	11·1
Lossiemouth	3,390	3,390	3,390	10,240	7,000	934	7·5
Millport	156	104	59	..	..	90	..
Montrose	20,126	34,454	50,867	45,350	45,650	4,348	10·5
Perth	42,110	41,415	43,740	43,580	43,070	4,281	10·1
Peterhead	37,059	36,872	35,935	34,975	33,876	3,292	10·3
Port Glasgow	39,125	38,593	38,103	36,019	38,000	2,422	15·7
Rothesay (Harbour and Dock)	2,717	2,367	2,168	1,881	1,471	508	2·9
Saltcoats	4,119	4,119	5,116	5,292	5,292	231	22·9
Stirling	..	..	1,650	2,259	1,600	356	4·5
Wick	7,236	7,317	7,121	6,156	5,227	737	7·1
Total Scotland	1,100,144	1,180,379	1,294,554	1,334,846	1,338,257	164,388	8·1
IRELAND.							
Ballina	500	250	..	..	..	187	..
Belfast	20,409	107,790	128,290	147,870	155,470	24,756*	6·2
Cork	16,857	15,057	12,857	12,107	9,957	9,897	1·0
Drogheda	12,365	12,031	11,295	10,758	9,620	3,533	2·7
Dublin	100,800	99,800	99,300	99,300	99,300	33,317*	3·0
Dundalk	1,250	4,250	11,650	13,650	18,150	2,017	9·0
Galway	21,000	21,000	22,000	22,757	22,328	2,100	10·6
Limerick (Harbour and Bridge)	126,512	126,512	126,513	126,512	131,512	4,204†	31·3
Newry	8,082	10,592	22,294	26,805	33,315	3,948	8·4
Portrush	2,500	2,500	2,500	2,500	4,875	1,343	3·6
Sligo	692	692	692	692	2,539	846	3·0
Wexford	3,765	3,765	4,765	4,765	4,535	2,497*	1·8
Total Ireland	314,732	404,239	442,155	467,716	491,601	88,645	5·5
Total United Kingdom	4,314,102	4,741,762	5,071,160	5,506,921	6,035,108	725,253	8·3

Ireland.

* These sums include £3,376 for pilotage at Belfast, £5,674 at Dublin, and above £800 at Wexford.
† Exclusive of the tolls of Wellesley Bridge.

APPENDIX B.
Supplement.

No. 323.
List of Printed Queries.

No. 323.

Printed Queries circulated to the several Ports and Harbours.

1. How situated—In a bay, or river, or open coast?
2. Sheltered, or exposed to what winds?
3. Natural or artificial, open. bar. pier, or tidal harbour?
4. Latitude, longitude? (of light-house or some marked spot).
5. Capacity, or area of sheltered anchorage?
6. Quality of holding ground? General depth of water?
7. Area above two fathoms. three fathoms, &c.?
8. Width and direction of entrance or entrances?
9. Depth of water at entrance at low water springs?
10. Rise of tide at springs and at neaps. and at extreme tides?
11. Time of high water on full and change days?
12. Rate of current or stream of tide? and the same in freshes?

CAPABILITY. SUPPLIES.

13. Number and areas of docks or floating basins? Tidal basins?
14. Number of building slips, patent slips, or repairing docks?
15. Number of graving docks? Width of dock-gates?
16. Extent of wharfage? Number and power of cranes?
17. What means of repairing steam machinery?
18. Number of men employed ship building?
19. Supply of provisions—of coal—of water—of stores—of masts?
20. Supply of coal fit for steamers—at what price? How readily?
21. Is there a low water pier? Is there a floating depôt of steam coal?
22. Is fresh water abundant and led down to the quays?
23. Chief traffic—foreign, coasting, inland?
24. Inland communication—rivers, canals, railways, roads?
25. Tonnage belonging to the Port—sailing vessels, steamers?
26. Steamers—1st class, 2nd class, tugs and ferry?
27. What the tonnage and horse power of each?
28. Number and tonnage of arrivals and sailings in the year—foreign, coasting?
29. Population of the Port?
30. Seafaring population—seamen, coasters, fishermen, boatmen?
31. Number of seamen registered?
32. Do the masters or mates of ships pass any examination?
33. Is such an examination thought desirable?

PLANS AND CHARTS.

34. Recent Plans of the Port—date, scale, author?
35. Old Plans—date, scale, author, probable accuracy?
36. Any Plans showing projected improvements?
37. Any Engineers' or other Reports on the harbour?
38. Best Charts of the coast? Sailing Directions?

ENGINEERING.

39. Present state of the harbour, or river up to the first bridge?
40. What changes have taken place—in deepening?
41. Changes in shoaling, or in the set of the tides?
42. Changes owing to encroachments or natural causes?
43. Changes by the removal or deposit of ballast or shingle?
44. Changes by the discharge of sewers or drains of factories into the stream?
45. Changes by the erection of piers, weirs, bridges, or piles?

ENGINEERING.

46. If artificial. by what authority made?
47. Proposed remedy for any damage caused?
48. Do existing laws give power to stop and remedy abuses?
49. Does the harbour show any tendency to silt up? At what rate?
50. If a bar forms across the mouth—Is it of sand, shingle, or rock?—Is it stationary or shifting?
51. What power of sluicing in the Port? Does it do good?
52. Number of cubic feet of water per minute, and from what distance procured?
53. With what success is it used, and how often required?
54. Is the bottom firm, and is dredging of any efficacy?
55. Is any dredging-machine in use—of what power?
56. Number of tons dredged up by day—and expense per ton?
57. Where is the soil removed to?
58. Of what materials are the piers or quays built?
59. Of what stone, and are they bored by sea-worms or the *pholas*, or *saxicava rugosa*?
60. What is the average, and what the maximum size of the stones used in their construction?
61. Of what timber, and are they bored by the *teredo navalis*, or any other worm?
62. Has any precaution been taken against it, and with what success?
63. If a river, what is the extent of its basin or country drained by it?
64. Available amount of back water?
65. Whole area of navigable river at high water?
66. Relative area at high and low water springs?
67. How high up is the tide felt?
68. Has the rise of tide been measured carefully at different points up the river?
69. Are these points referred to one common *datum* line?
70. Where is the *datum* or zero line, and how marked?
71. To what distance from its mouth is the river navigable?
72. What distance to the first bridge?
73. Is the river much affected by freshes?

GOVERNMENT, LIGHTS, &c.

74. Is the harbour governed by Trustees or Commissioners?
75. What their names and occupations?
76. Under what Act of Parliament?
77. Date of Charter, if any?
78. What authority to levy dues? Annual amount of dues?
79. Any exemption from dues at other ports?
80. Is any passing toll levied?
81. Qualification necessary for a Trustee or Commissioner?
82. Does he derive any emolument from the office?
83. Is there a resident Engineer, Harbour-Master, or Deputy?
84. Under what Board do the pilots act?
85. Number of pilots? Sufficient for the traffic? Charges?
86. Where do they pass their examination?
87. Under what Board are the lights, &c.? What light dues levied?
88. What coast or harbour-lights, or light-vessels?
89. Do they burn gas, rape-seed oil, or sperm oil?

APPENDIX B.
Supplement.

No. 323.
List of Printed Queries.

GOVERNMENT, LIGHTS, &c.—*continued.*

90. What is the number of burners, and the annual expense of maintenance?
91. Are there sufficient lights, buoys, beacons, and sea marks?

INCOME AND EXPENDITURE.

92. Amount of revenue of port? For some years back?
93. From shore dues, and what other sources?
94. Is there any debt; what interest paid, and to whom?
95. Is the sinking fund annually increased?
96. Annual expenditure, in detail?
97. Is any annual amount expended in repairs and improvements?
98. Total amount expended in improvements?
99. Total amount empowered to raise by Act of Parliament?

FISHERIES.

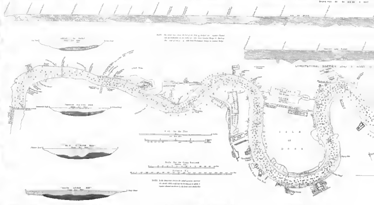
100. What the extent and value of the river and coast fisheries?
101. Number of smacks or boats, and men employed in them?
102. Number of trawlers and liners?
103. Do they supply the poor with cheap food?
104. Are they capable of extension if more capital were found?
105. Any asylums or endowments for decayed fishermen or seamen?
106. Any provision for pensioning their widows or educating their children?

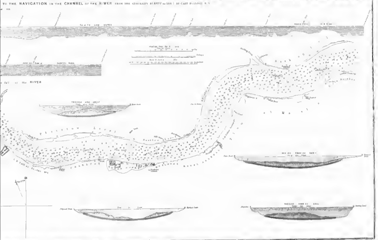
RESOURCES, &c.

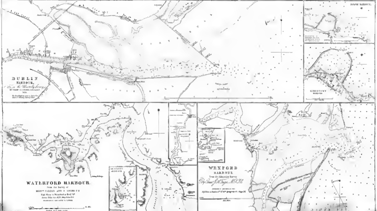
107. Is land to be had easily for docks or slips if required?
108. Are there quarries of building stone in the neighbourhood, and what are the largest blocks that can be procured?
109. What is, briefly, the geological character of the country around? Are there coal-pits or mines?
110. Any shingle beaches in the vicinity?
111. Is there a life-boat, or rocket, or mortar, in case of wreck?
112. Is there an Admiralty Chart Agent resident?
113. Is a journal kept of the wind, weather, barometer, wrecks, &c.
114. Is there a tide-scale? Is it registered daily, or is there a self-registering tide-gauge? and is this accompanied by a barometric register?
115. Can a ship be supplied with a chronometer near at hand?
116. Is there an astronomical clock, or the means of giving time to ships by a time ball?
117. Is there any harbour of refuge in the neighbourhood?
118. Where do the chief wrecks occur, and what the cause?
119. Name the best point for a harbour of refuge along this coast?
120. What are the military defences of the harbour?
121. Suggest any works for improvement of port?
122. Or generally for the benefit of navigation in the neighbourhood?

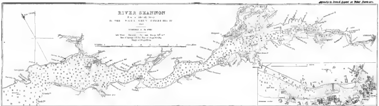
LONDON:—Printed by WILLIAM CLOWES and SONS, Stamford Street,
For Her Majesty's Stationery Office.

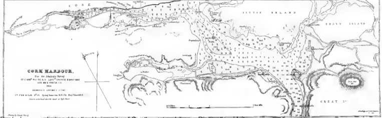
THE RIVER THAMES FROM WESTMINSTER TO BARKING SHEWING THE OBSTRUCTIONS TO THE

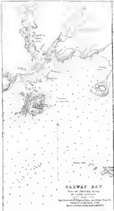

LONGITUDINAL SECTION along the middle
ISLE OF DOGS
Scale for the Plan
Scale for the Cross Sections
NOTE


TO THE NAVIGATION IN THE CHANNEL OF THE RIVER FROM THE ADMIRALTY SURVEY
of the RIVER
LOW WATER

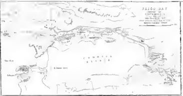

DUBLIN
HARBOUR,
From the Admiralty Survey
1838.
HOWTH HARBOUR.
KINGSTOWN
HARBOUR.
WATERFORD HARBOUR
From the Survey of
MESSRS. FRAZER AND ... C.E.
WEXFORD
HARBOUR
from the Admiralty Survey


RIVER SHANNON
From the Admiralty Survey
1844

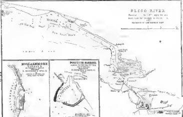

CORK HARBOUR,
From the Admiralty Survey
1844
CORK
SPIKE ISLAND
FOATY ISLAND
GREAT I.



GALWAY BAY
From the Admiralty Survey
BY COMMR BEECHEY
1848

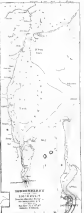


SLIGO BAY

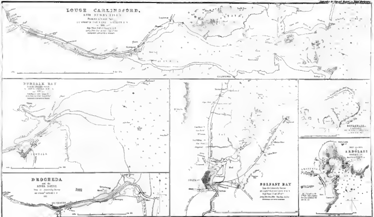


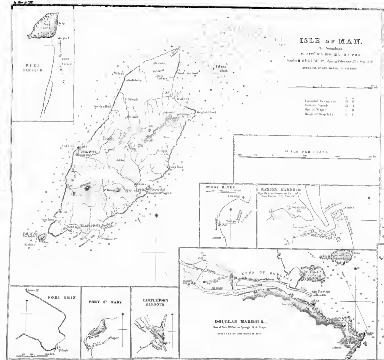
SLIGO RIVER

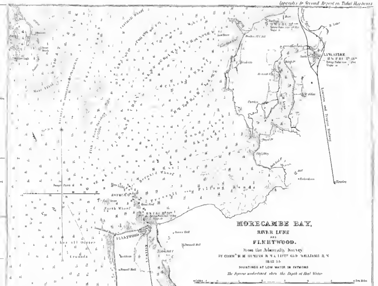
MULLAGHMORE HARBOUR



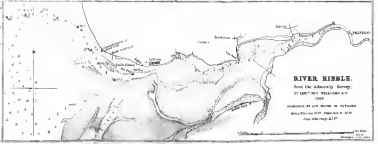
LONDONDERRY
AND
LOUGH FOYLE
From the Admiralty Survey
BY COMMR FRAZER R.N.
1848


LOUGH CARLINGFORD,
AND NEWRY RIVER
CARLINGFORD
DUNDALK BAY
DUNDALK
DROGHEDA
and the
RIVER BOYNE
From the Admiralty Survey
DROGHEDA
BELFAST BAY
From the Admiralty Survey
BELFAST
DONAGHADEE
ARDGLASS
ARDGLASS

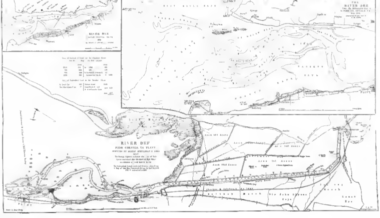

ISLE of MAN.
By Captn W. S. ... R.N. F.R.S.
SOUNDINGS AT LOW WATER IN FATHOMS
Equinoctial Springs rise
Ordinary Springs
Rise at Neaps
Range of Neap Tides
SCALE FOR ...
PEEL HARBOUR
PEEL TOWN
RAMSEY
Maughold Head
Laxey
Clay Head
DOUGLAS
Castletown
Port Erin
Calf of Man
Chicken R.
DERBY HAVEN
RAMSEY HARBOUR
TOWN OF DOUGLAS
Old Bridge
DOUGLAS HARBOUR
PORT ERIN
Village
PORT St MARY
CASTLETOWN HARBOUR

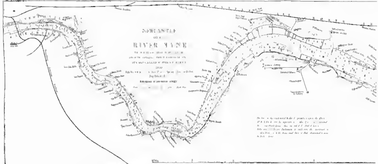


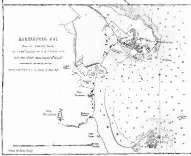
MORECAMBE BAY,
RIVER LUNE
AND
FLEETWOOD.
From the Admiralty Survey
BY COMMR H M DENHAM R N & LIEUT GEO WILLIAMS R N
1842 55
SOUNDINGS AT LOW WATER IN FATHOMS
The Figures underlined shew the Depth at Half Water

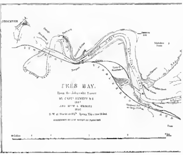


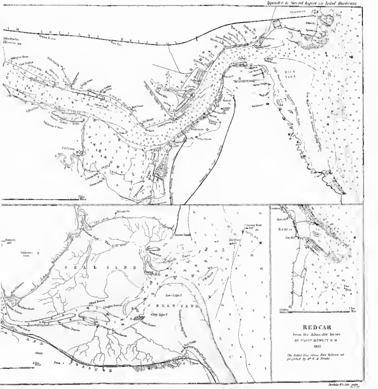
RIVER RIBBLE.
From the Admiralty Survey
BY LIEUT GEO WILLIAMS R.N
1846
SOUNDINGS AT LOW WATER IN FATHOMS
Spring Tides rise 28 Ft Neaps rise to 24 Ft
Neap Tides range 15 Ft


RIVER DEE
FROM CHESTER TO FLINT
SURVEYED BY ROBERT STEVENSON & SONS
THE RIVER DEE
RIVER DEE
FLINT
Saltney Marsh
Sir John Glynnes Cop


NEWCASTLE
AND
RIVER TYNE
1849
Soundings at low water in feet


HARTLEPOOL BAY
From the Admiralty Survey
Soundings at low water in feet
Figures underlined show the Depths at High Water
Drawn by Jesse Purdy

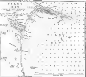

TEES BAY.
From the Admiralty Survey
By Capt. Hewett R.N.
1825
and Mr W. L. Brookes
1846
Soundings below water in fathoms
Stockton
Newport

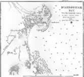


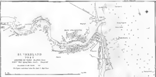
REDCAR
From the Admiralty Survey
BY CAPTN HEWETT R N
1832

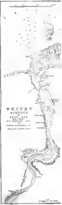
The Dotted line shews Pier Wilson as projected by Mr W. A. Brooks

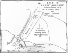
Standidge & Co. Litho London

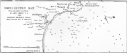

FILEY BAY
FILEY BAY

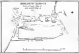

SCARBOROUGH BAY

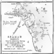

SUNDERLAND PORT

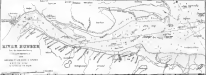

WHITBY HARBOUR and RIVER ESK

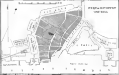

PORT OF GREAT GRIMSBY

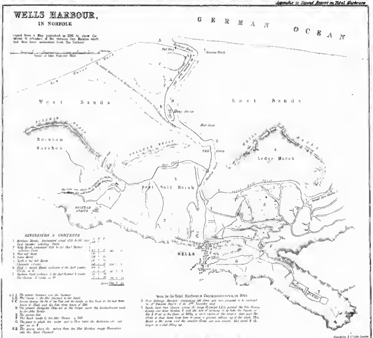

BRIDLINGTON BAY


BRIDLINGTON HARBOUR


SEAHAM HARBOUR


RIVER HUMBER


PORT of KINGSTON UPON HULL
OLD DOCK
HUMBER DOCK
RIVER HUMBER



WELLS HARBOUR,
IN NORFOLK

Copied from a Map published in 1782 to shew the extent & situation of the various Salt Marshes which had then been embanked from the Harbour

Scale of One Statute Mile

REFERENCES & CONTENTS

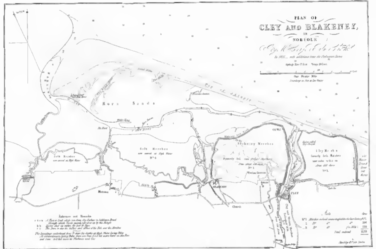
		A	R	P			
1	Holkham Marsh, Embanked about 1718 by the late Lord Leicester including Creeks	[illegible]					
2	Wells Marsh, Embanked 1719 by Sir Chas Turner including Creeks	[illegible]			[illegible]		
3	West Salt Marsh	[illegible]					
4	Lodge Marsh	[illegible]					
5	North or Salt Marsh	[illegible]					
	Channels & Creeks	[illegible]			[illegible]		
6	East & Church Marsh exclusive of the Roads Creeks	[illegible]					
	Creeks in D	[illegible]			[illegible]		
7	Warham Grade exclusive of the Roads Channel & Creeks	[illegible]					
	The Channel & Creeks in Do	[illegible]			[illegible]		
					Acres [illegible]		

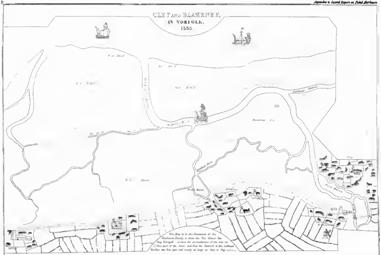
- A A A The present Entrance into the Harbour
- B B The Course of the Old Channel by the Beach
- C C Arrow shewing the Set of the Tide over the Sands on this Coast in the last three hours of Flood and the first three hours of Ebb
- D The present Navigable Channel at the Bridge since the Embankment made by Sir John Turner
- E The present Pool
- F The Bank made by Sir John Turner in 1758
- G The place to which the water used to flow before the Embankment was put up at F
- H H The places where the waters from the West Marshes empty themselves into the Main Channel

Notes by the Tidal Harbours Commissioners, in 1844.

3. These Saltings Marshes containing [illegible] Acres are now proposed to be enclosed by Mr [illegible] [illegible] of the 5th November 1843

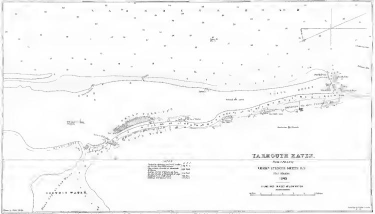
5. Banks have been thrown across the large Creeks (at L.L.) to prevent the Tide flowing directly over these Marshes & with the view of forming it to take the Course of [illegible] & [illegible] by the Quay at Wells, a [illegible] The effects of these dams have been to cause a general silting up of the whole. This Marsh is [illegible] and the smaller Creeks are now nearly silted [illegible] & the larger in a [illegible] silting up


PLAN OF
CLEY AND BLAKENEY,
IN
NORFOLK
In 1835 … with additions from the Ordnance Survey
Springs Rise 17 Feet Neaps 10 Feet
One Nautic Mile
Soundings in Feet at Low Water
Horn Sands
Salt Marshes now saved at High Water
Salt Marshes now saved at High Water No 4
Blakeney Marshes
Formerly Salt now Fresh Marshes No 1
Cley Marsh formerly Salt Marshes
Old Wall
BLAKENEY
CLEY
Morston
Church
Cley and Wiveton Marshes Embanked 1824 No 3
References and Remarks
a a a A Fleet or Creek which ran from Cley Harbour to Salthouse Broad through which Vessels passed, now filled up by the Shingle
b b Sluice shut up within the last 20 Years
c c The Dam to stop the Influx and Efflux of the Tide over the Meadow
The Soundings underlined thus show the depths at High Water Spring Tides
At extraordinary Spring Tides there are from 4 to 6 feet more water on the Bar and from 2 to 3 feet more at Blakeney and Cley
Note
No 1 Marshes enclosed commencing within the last Century 471 Acres
2 Do do do 396
3 Do do 1824 238
Total enclosed 1105
Standidge & Co Litho London



CLEY AND BLAKENEY, IN NORFOLK, 1586

This Map is in the Possession of the Heathcote Family, to whom the Cley Manor has long belonged. It shows the encroachment of the Sea on this part of the Coast and that the Channel to the Salthouse Sluice was then open and nearly as large as that to Cley.



YARMOUTH HAVEN,

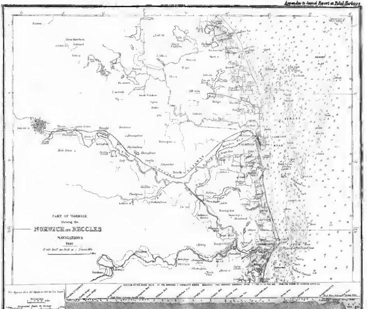
From a PLAN by

COMMR SPENCER SMYTH R.N.

Pier Master,

1845

SOUNDINGS IN FEET AT LOW WATER


PART OF NORFOLK
Showing the
NORWICH AND BECCLES
NAVIGATIONS
1846
NORWICH
YARMOUTH
BECCLES
Brundall
Reedham
Herring Fleet
Haddiscoe
Acle
Lowestoft